CITY OF LOS ALAMITOS

3191 Katella Avenue
Los Alamitos, CA 90720

AGENDA
TRAFFIC COMMISSION
REGULAR MEETING
Wednesday, July 13, 2016 – 7:00 P.M.

NOTICE TO THE PUBLIC

This Agenda contains a brief general description of each item to be considered. Except as provided by law, action or discussion shall not be taken on any item not appearing on the agenda. Supporting documents, including staff reports, are available for review at City Hall in the Engineering Office or on the City's website at www.cityoflosalamitos.org once the agenda has been publicly posted.

Each matter on the agenda, no matter how described, shall be deemed to include any appropriate motion, whether to adopt a minute motion, resolution, payment of any bill, approval of any matter or action, or any other action. Items listed as "for information" or "for discussion" may also be the subject of an "action" taken by the City Council at the same meeting.

Any written materials relating to an item on this agenda submitted to the Traffic Commission after distribution of the agenda packet are available for public inspection in the Engineering Office, 3191 Katella Ave., Los Alamitos CA 90720, during normal business hours. In addition, such writings or documents will be made available for public review at the respective public meeting.

It is the intention of the City of Los Alamitos to comply with the Americans with Disabilities Act (ADA) in all respects. If, as an attendee, or a participant at this meeting, you will need special assistance beyond what is normally provided, please contact the Engineering Office at (562) 431-3538, extension 301, 48 hours prior to the meeting so that reasonable arrangements may be made. Assisted listening devices may be obtained from the Traffic Commission Secretary at the meeting for individuals with hearing impairments.

Persons wishing to address the Traffic Commission on any item on the Traffic Commission Agenda shall sign in on the Oral Communications Sign-In Sheet which is located on the podium once the item is called by the Chairperson. At this point, you may address the Traffic Commission for up to *FIVE MINUTES* on that particular item.

1. CALL TO ORDER

2. ROLL CALL

Chair Patz
Vice Chair Biri
Commissioner Emerson
Commissioner Mejia
Commissioner Seaman
Commissioner Wilhelm

3. PLEDGE OF ALLEGIANCE

4. ORAL COMMUNICATION

At this time any individual in the audience may address the Traffic Commission and speak on any item within the subject matter jurisdiction of the Commission. Please state if you wish to speak on an item on the Agenda. **Remarks are to be limited to not more than five minutes.**

5. APPROVAL OF MINUTES

A. Approve the Minutes for the Regular Meeting of June 8, 2016.

6. STAFF REPORTS

A. Consideration of a Signal Modification at Los Alamitos Boulevard at Rossmoor Way and Bradbury Road

A request has been received by the Traffic Commission to look at changing the left-turn signal phases at Los Alamitos Boulevard @ Rossmoor Way and Bradbury Road going into the Highlands Neighborhood.

Recommendation: Based on the findings of Staff's analysis, the installation of protected-permissive left-turn phasing is not recommended.

7. ITEMS FROM THE PUBLIC WORKS DEPARTMENT

A. Traffic Commission Status Log.

8. TRAFFIC COMMISSION INITIATED BUSINESS

At this time, Commissioners may report on items not included on the agenda, but no such matter may be discussed, nor may any action be taken in which there is interest to the community, except as to provide Staff direction to report back or to place the item on a future agenda.

9. ADJOURNMENT

I hereby certify, under penalty of perjury under the laws of the State of California that the foregoing Agenda was posted at the Community Center, Museum, and City Hall not less than 72 hours prior to the meeting. **Dated this 7th day of July, 2016.**

Dawn Sallade

Dawn Sallade, Department Secretary

MINUTES OF TRAFFIC COMMISSION MEETING OF THE CITY OF LOS ALAMITOS

REGULAR MEETING – June 8, 2016

1. CALL TO ORDER

A Regular meeting of the Traffic Commission was called to order at 7:06 PM on June 8, 2016, in the Council Chambers, 3191 Katella Avenue, Los Alamitos, California, Chair Patz presiding.

2. ROLL CALL

Present: Commissioners:

Chair Daniel Patz
Vice Chair Gina Biri
Commissioner Dave Emerson
Commissioner Javier Mejia
Commissioner James Wilhelm

Absent: Commissioner Jason Seaman

Chair Patz reported that Commissioner Seaman notified both he and the Department Secretary via email a few weeks ago that he would be out of town on business and would be absent from this meeting. This will be counted as an excused absence.

Present: Staff:

Steven Mendoza, Development Services Director
Vanessa Munoz, Traffic Engineer
Sergeant Gallagher, Police Department
Dawn Sallade, Department Secretary

3. PLEDGE OF ALLEGIANCE

The Pledge of Allegiance was led by Vice Chair Biri.

4. ORAL COMMUNICATIONS

Chair Patz opened the meeting for Oral Communications. There being no speakers, the Chair closed Oral Communications.

5. INTRODUCTION

Introduction of Vanessa Munoz as Traffic Engineer, Ruth Smith's temporary replacement.

Development Services Director Steven Mendoza introduced Ms. Munoz and gave a brief overview of her qualifications and her duties at Willdan Engineering.

Ms. Munoz indicated she'll be handling the Traffic Commission meetings until another employee of Willdan Engineering takes the Traffic Engineer duties. She expanded on her experience

6. APPROVAL OF MINUTES

A. Approve the Minutes for the Regular Meeting of May 11, 2016.

Chair Patz pointed out a correction on:

- Page 7, Section 8, second line, "...need to come *before* the Commission...".

Commissioner Wilhelm pointed out a correction on:

- Pages 5, second line from the bottom, "...stipulate that a business *must provide* the sufficient parking...".

Commissioner Emerson pointed out the following corrections:

- Page 5, fifth paragraph, fifth sentence, "...anything necessary on the right *(south) of each exit*. He reported that from his own...".

- And on Page 4, fifth paragraph, first line, "...read into record a letter from Ralph Vardabedian...". He said he felt that that letter should be attached to the back of the official Minutes or summarized or something since they were read into record. He said he would like to have it added as it's an important piece of the discussion.

- Page 7, fourth paragraph, third line, "Following discussion, it was determined that *the "Limit Lines" and "Keep Clear" on F-9 (Farquhar & Pine)* would remain but *the "Limit Lines" and "Keep Clear" lines on F-10 (Farquhar & Cherry)* will be removed."

Chair Patz pointed out a correction:

- Page 7, second paragraph, first line, "Chair *Patz* asked what the status...".

Motion/Second: Biri/Mejia
Unanimously Carried 5/0/0 (Seaman absent): The Traffic Commission approved the minutes of the Regular meeting of May 11, 2016, with corrections as noted above.

7. STAFF REPORTS

A. Continuing Education – "Setting Speed Limits"

Staff will present the Commission with a PowerPoint presentation on setting speed limits.

Traffic Engineer Vanessa Munoz summarized the Staff report and educated the Traffic Commission and Staff on the process of setting speed limits.

Following a long discussion, the Traffic Commission thanked Ms. Munoz for her most informative presentation.

8. TRAFFIC COMMISSION INITIATED BUSINESS

Commissioner Mejia

- Asked about the parking signs that were put up at Laurel Park as they still have the blank spot where the Municipal Code section should be and wondered if this is a necessity.

  Ms. Munoz indicated that Ruth Smith had followed up with the City Attorney regarding this and he indicated that the Municipal Code section does not need to be on the sign.

Commissioner Emerson

- Bloomfield and Cerritos intersection – Would be a logical place for a protected/permissive traffic light.

  Mr. Mendoza indicated this is on the 7-year CIP list but it won't be in the first year of that 7-year plan.

  Officer Gallagher interjected that from a law enforcement standpoint, it would be an incredibly dangerous situation for this to occur. This is due to the proximity of the school as this tends to be where the greatest threat is due to the driver watching for traffic instead of pedestrians crossing the road.

  Commissioner Emerson withdrew his request.

- Protected/permissive traffic light at the two entrances to Rossmoor Highlands which is Rossmoor Way and Bradbury Way. It is a protected light currently.

  Officer Gallagher indicated he sees no safety issue with this request.

  Chair Patz inquired as to the cost of conversion.

  Ms. Munoz answered that the cost would vary depending on what size pole there is currently. She would have to do some research before giving cost information.

  Ms. Munoz indicated that from a traffic engineering standpoint, she would have to research the history of why this intersection was fully protected instead of protected/permission. For liability purposes, Staff would have to document it very clearly before downgrading.

Motion/Second: Emerson/Mejia
Carried 5/0/0 (Seaman absent): The Traffic Commission approved the request to agendize the proposed Protected/Permissive traffic light at the two entrances to Rossmoor Highlands on Rossmoor Way and Bradbury Way (south bound left turns only) and also include a rough pricing estimate in the information as well.

Commissioner Mejia asked on a study such as this, wouldn't it be more common to do both north bound and south bound?

Ms. Munoz answered that that is correct. There are some cities that do use the mix of operation and she feels that that kind of operation is such that it confuses the drivers. Most municipalities tend to be consistent (both protected and protected/permissive).

Following discussion, Commission Emerson wanted to amend his motion as follows:

Motion/Second: Emerson/Mejia
Carried 5/0/0 (Seaman absent): The Traffic Commission approved the request to agendize the proposed Protected/Permissive traffic light at the two entrances to Rossmoor Highlands on Rossmoor Way and Bradbury Way (south bound and north bound) and also include a rough pricing estimate in the information as well.

- Reported he would not be present at the July Traffic Commission meeting.

9. ADJOURNMENT

The Traffic Commission adjourned at 8:07 PM.

City of Los Alamitos
Traffic Commission

Agenda Report	July 13, 2016
Staff Report	Item No: 6A

To: **Chair Patz and Members of the Traffic Commission**

From: **Vanessa Munoz, Traffic Engineer**

Subject: **Consideration of a Signal Modification at Los Alamitos Boulevard at Rossmoor Way and Bradbury Road**

Summary: A request has been received by the Traffic Commission to look at changing the left-turn signal phases at Los Alamitos Boulevard at Rossmoor Way and Bradbury Road going into the Highlands Neighborhood.

Recommendation: Based on the findings of Staff's analysis, the installation of protected-permissive left-turn phasing is not recommended.

Background

Hartzog & Crabill, Inc. (HCI) has completed a Left-Turn Phasing Warrant Analysis for the subject intersections. The analysis was completed on November, 2012 in response to the City's request to verify if protected-permissive left-turn phasing is warranted, and recommended based on meeting standard guidelines.

Recommendation

At the present time, the intersections are signalized with a 5-phase operation with protected left-turn phasing on Los Alamitos Boulevard. The California Manual of Uniform Traffic Control Devices (*California MUTCD*) was used for defining the requirements for left-turn phasing, as well as the Highway Capacity Manual (*HCM*) and Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. Based on these guidelines, there are four conditions considered for left-turn phasing:

1) Accident History;

2) Delay;

3) Traffic Volumes; and

4) Miscellaneous (*i.e., impaired sight distance, roadway curvature, etc.*).

Based on the findings of the analysis, the installation of protected-permissive left-turn phasing is not recommended due to the following reasons:

Los Alamitos Boulevard and Rossmoor Way

There were sufficient traffic volumes that met all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.

Sight distance is considered restrictive for the northbound left-turning driver, as the actual sight distance measured to the nearest oncoming lane of traffic is less than 400 feet when a vehicle was in the opposing left-turn lane.

There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers would need to account for under the 'permissive' portion.

Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, and one left-turn collision still occurred within the last 10 years, it can be expected that an increase in left-turn type accidents will occur if modified to protected-permissive.

Los Alamitos Boulevard and Bradbury Road

There are sufficient traffic volumes that satisfy all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.

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There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers need to account for under the 'permissive' portion. The northbound approach (south leg of the intersection) has a posted speed limit of 45 MPH, which is considered 'higher' roadway speeds. Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected that left-turn type accidents may occur if modified to protected-permissive

To comply with current CA MUTCD guidelines for traffic signal timing, a Citywide traffic signal timing analysis is being performed on all signalized intersections. Once completed, a more focus review of the left turn phasing operation for the subject intersections can be furthered analyzed to ensure the left turn phasing operation has been optimized.

Fiscal Impact

None

Attachments:
1) *Left Turn Phasing Analysis – Los Alamitos Boulevard Rossmoor Way*
2) *Left turn Phasing Analysis – Los Alamitos Boulevard Bradbury Road*
3) *Traffic Commission Staff Report - December 12, 2012*
4) *Meeting Minutes - December 12, 2012*

ATTACHMENT 1

HARTZOG & CRABILL, Inc.

Trammell Hartzog, President
Jerry Crabill, P.E. (Retired)
Gerald J. Stock, P.E., Executive Vice-President

17772 E. 17th Street
Suite 101
Tustin, CA 92780

Phone: (714) 731-9455
FAX: (714) 731-9498

www.hartzog-crabill.com

November 7, 2012

Mr. Dave Hunt, P.E.
Director of Public Works/City Engineer
City of Los Alamitos
3191 Katella Avenue
Los Alamitos, CA 90720

Subject: Left-Turn Phasing Analysis at the Intersection of Los Alamitos Boulevard and Rossmoor Way

Dear Mr. Hunt:

Hartzog & Crabill, Inc. (HCI) has completed a Left-Turn Phasing Warrant Analysis for the subject intersection. As you will see in the attached report, the findings of this study show that the modification from protected to protected-permissive left-turn phasing on Los Alamitos Boulevard is not recommended for this intersection.

The analysis was completed in response to the City's request to verify if protected-permissive left-turn phasing is warranted, and recommended based on meeting standard guidelines. At the present time, the intersection is signalized with a 5-phase operation with protected left-turn phasing on Los Alamitos Boulevard. The California Manual of Uniform Traffic Control Devices (*California MUTCD*) was used for defining the requirements for left-turn phasing, as well as the Highway Capacity Manual (*HCM*) and Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. Based on these guidelines, there are four conditions considered for left-turn phasing: 1) Accident History; 2) Delay; 3) Traffic Volumes; and 4) Miscellaneous (*i.e., impaired sight distance, roadway curvature, etc.*).

Based on the findings of our analysis, the installation of protected-permissive left-turn phasing is not recommended due to the following reasons:

- There were sufficient traffic volumes that met all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.
- Sight distance is considered restrictive for the northbound left-turning driver, as the actual sight distance measured to the nearest oncoming lane of traffic is less than 400 feet when a vehicle was in the opposing left-turn lane.

- There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers would need to account for under the 'permissive' portion.
- Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, and one left-turn collision still occurred within the last 10 years, it can be expected that an increase in left-turn type accidents will occur if modified to protected-permissive.

It has been our pleasure to prepare this analysis for the City of Los Alamitos. If you have any questions or need more information please call (714) 731-9455.

Regards,
HARTZOG & CRABILL, INC.

Mark J. Esposito

Mark J. Esposito, PE, TE, PTOE
Project Manager

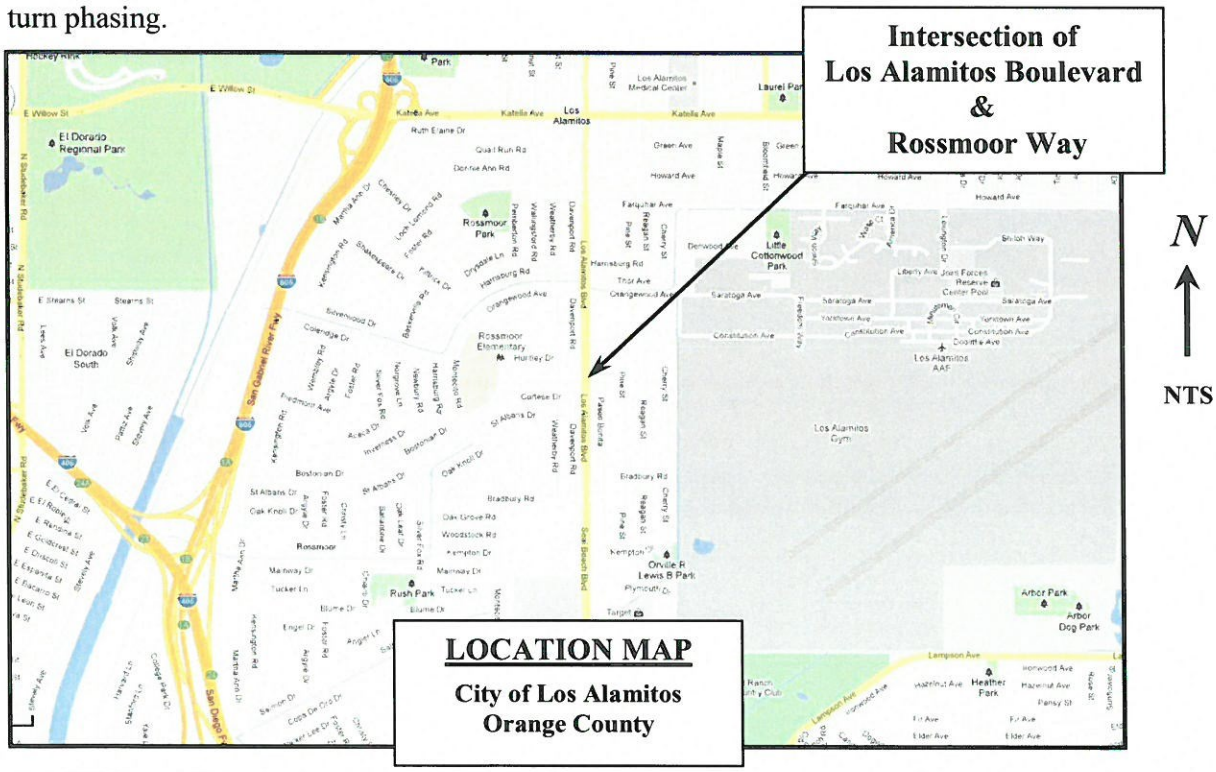
Attach: Left-Turn Phasing Analysis Report

LEFT-TURN PHASING ANALYSIS:

INTERSECTION OF
LOS ALAMITOS BOULEVARD AND ROSSMOOR WAY
IN THE CITY OF LOS ALAMITOS, CA

INTRODUCTION

The City of Los Alamitos requested Hartzog & Crabill, Inc. (HCI) to complete a Left-Turn Phasing Warrant Analysis at the intersection of Los Alamitos Boulevard and Rossmoor Way. This analysis was completed in order to verify if protected-permissive left-turn phasing is warranted for the left-turns on Los Alamitos Boulevard onto Rossmoor Way, and recommended based on meeting standard guidelines. The location is a residential intersection with Los Alamitos Boulevard running in the north-south directions and Rossmoor Way in the east-west directions. The intersection is located east of the I-605 Freeway, and south of Katella Avenue (*see Location Map below*). Presently, the intersection is signalized with a 5-phase operation, with protected left-turn phasing on the northbound and southbound approaches. This analysis will study if the protected left-turn phasing on Los Alamitos Boulevard may be modified to protected-permissive left-turn phasing.



BACKGROUND

Los Alamitos Boulevard is a north-south major arterial roadway. At the intersection with Rossmoor Way, the roadway has residential properties on both sides and a street width of approximately 90 feet. The painted striping provides for three through lanes of traffic with a dedicated left-turn lane for each direction. There is a raised landscaped median on both legs of Los Alamitos Boulevard, and curb, gutter, and sidewalk improvements along both sides of the roadway. Los Alamitos Boulevard has a posted speed limit of 40 MPH. On-street parking is restricted on both sides of the road with No Stopping Any Time signs. Currently, the traffic signal provides for protected left-turn phasing on Los Alamitos Boulevard when turning left onto Rossmoor Way.

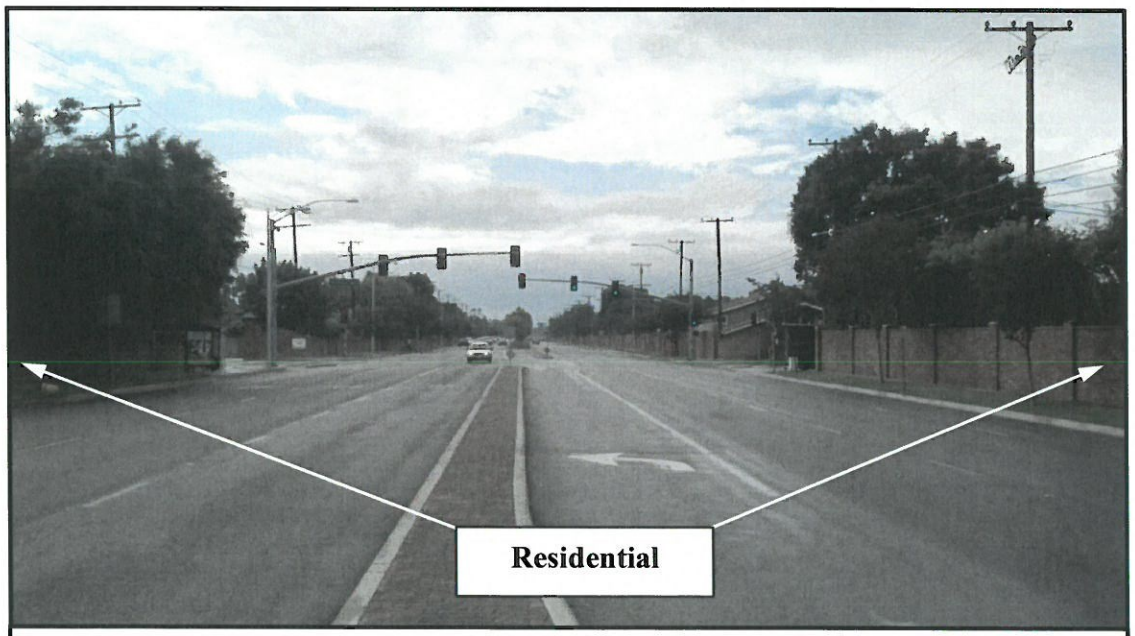
See Exhibit 1 (next page) for photo images of Los Alamitos Boulevard.

Rossmoor Way is a residential roadway that varies in street width at its intersection with Los Alamitos Boulevard, with a 76-foot street width on the west leg and 60 feet on the east leg. The striping also varies at the intersection, with two through lanes of traffic in each direction on the west leg, and a single lane of traffic in each direction on the east leg. The directions on both legs are separated by raised landscaped medians. There are curb, gutter, and sidewalk improvements along both sides of Rossmoor Way, which has a posted speed limit of 25 MPH. On-street parking is allowed on both sides of the roadway, with exception to some red curb on the east leg near the intersection. Currently, the traffic signal provides for permissive phasing on Rossmoor Way when turning left onto Los Alamitos Boulevard.

See Exhibit 2 (following page) for photo images of Rossmoor Way.

EXHIBIT 1

Los Alamitos Boulevard (*Looking Northbound*) @ Rossmoor Way



Los Alamitos Boulevard (*Looking Southbound*) @ Rossmoor Way

EXHIBIT 2

Rossmoor Way (*Looking Eastbound*) @ Los Alamitos Boulevard

Rossmoor Way (*Looking Westbound*) @ Los Alamitos Boulevard

LEFT-TURN PHASING ANALYSIS

The approach for this analysis follows typical left-turn phasing warrant studies (i.e., analysis of warrants for protected left-turn phasing when only permissive phasing exists). However, as the intersection already has protected left-turn phasing, particular guidelines will be focused on and under careful consideration to help determine if the possible modification to protected-permissive is recommended or not.

As is common practice with many municipal agencies, the City of Los Alamitos has an adopted practice for using State guidelines as reference standards in order to provide uniformity and consistency in terms of traffic control. Therefore, the following three prevailing sources that address this topic were considered: 1) State of California Manual of Uniform Traffic Control Devices (*California MUTCD*); 2) State of California Highway Capacity Manual (*HCM*); as well as 3) Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. These sources were referenced because some diversity exists between them regarding left-turn phasing guidelines ***(see Appendix A for all three applicable guidelines)***.

Based on the comprehensive State guidelines found in the California MUTCD, which are most-typically referenced, there are four conditions that are considered for left-turn phasing: 1) Accident History; 2) Volume; 3) Delay; and 4) Miscellaneous. If any one of these conditions is met, then protected left-turn phasing should be considered.

Accident history, traffic volume data, and sight distance (visibility) are the conditions most often studied by HCI for this type of analysis, since they provide a good overall picture of the intersection characteristics. Consequently, the following analysis has focused on these three conditions to determine if protected-permissive left-turn phasing is warranted and recommended for the northbound and southbound approaches of Los Alamitos Boulevard.

Accident History

The guidelines for left-turn phasing contained in the California MUTCD regarding accidents require a minimum of five (5) left-turn collisions for a particular left-turn movement during a recent 12-month period. The HCM does not include guidelines on collisions; however, the ITE guidelines do call for a minimum of (8) left-turn-related accidents occurring within the last three years at any one approach with permissive-only phasing.

In recognition that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected that there may be no (or minimal) left-turn type accidents. Typically, left-turn type accidents are categorized as 'Broadside' or 'Head-On'. If there are a considerable amount of these types of accidents still occurring, then the finding may not support modification to protected-permissive left-turn phasing.

The available accident history reported for the intersection was gathered from the California Highway Patrol Statewide Integrated Traffic Records System (SWITRS). More specifically, a comprehensive 10-year traffic collision history summary report was prepared and reviewed for any left-turn type collisions (***attached in Appendix B)***.

As shown in the summary report, there were a total of (24) collisions reported at or near this intersection between years 2001 and 2011. Of these, only one was found involving north-south left-turning movements at the intersection (highlighted). Therefore, protected-permissive left-turn phasing may be further considered, if other factors such as 'less than minimum' traffic volumes and adequate sight distance support it as well.

Traffic Volumes

Again, recognizing that this intersection already has protected left-turn phasing on Los Alamitos Boulevard, it can be expected that minimum left-turn traffic volumes are met for this installation. If the minimum left-turn volume guidelines are not reached, the finding may further support modification to protected-permissive left-turn phasing.

Traffic Volumes (continued)

As stated in the California MUTCD and noted below, protected left-turn phasing should be considered when the following left-turn traffic volume criteria are met:

> ***For a pretimed signal or a background-cycle-controlled actuated signal, a left turn volume of more than two vehicles per approach per cycle for a peak hour; or for a traffic-actuated signal, 50 or more left turning vehicles per hour in one direction with the product of the turning and conflicting through traffic during the peak hour of 100,000 or more.***

This particular intersection is a semi-actuated traffic signal since it has vehicle detection loops on each approach. Therefore, (50) or more left-turning vehicles per hour in one direction are required, along with the left/conflicting-through vehicle product of 100,000. The ITE guidelines similarly have minimum cross-products of 100,000 and 144,000 when opposed by 3 or 2 lanes, respectively.

It is noted, the conflicting-through, or opposing, traffic volumes used in this analysis do include the right-turning traffic. This is due to left-turning drivers on Los Alamitos Boulevard most likely yielding to right-turners as well as through-traffic since it may require merging/sharing the Rossmoor Way lane.

Intersection peak-hour turning movement counts were gathered at the intersection of Los Alamitos Boulevard and Rossmoor Way to determine the activity level during a typical mid-week time period. The traffic volumes were collected on Tuesday, September 18, 2012. The morning peak-hour was determined to start at 7:15 AM and the afternoon peak-hour at 4:45 PM.

Peak-hour traffic volume data is included in Appendix C.

Table 2 on the next page summarizes the weekday peak-hour traffic counts.

Traffic Volumes (continued)

TABLE 2
INTERSECTION WEEKDAY
PEAK-HOUR VEHICLE TURNING MOVEMENT COUNTS

Intersection	Peak Hour	Northbound			Southbound			Eastbound			Westbound		
		L	T	R	**L**	T	R	**L**	T	R	**L**	T	R
Los Alamitos Boulevard and Rossmoor Way	AM	**72**	1476	7	**33**	1237	100	**175**	19	66	**9**	33	110
	PM	**30**	1429	13	**95**	1698	59	**54**	8	36	**8**	5	59

L = Left-turning vehicles
T = Through vehicles
R = Right-turning vehicles

As highlighted in Table 2 above, the northbound and southbound left-turn movements meet the minimum (50) left-turning vehicles per hour in one direction that is needed to partially satisfy the California MUTCD Traffic Volume guideline described above.

The remaining portion of the guideline specifies that the product of the left-turning movement and the conflicting-through traffic during the peak-hour equal 100,000 or greater. As shown in Table 3 below, this portion of the guideline is satisfied for the southbound left-turn approach to the intersection, while the northbound approach is imminent (96%). The northbound approach can be considered satisfied as another day's count may result in the difference of three more vehicles. Therefore, the volumes do meet the minimum product of 100,000 per CA MUTCD and ITE guidelines.

TABLE 3
LEFT-TURN PHASING CROSS-PRODUCT CHECK
LOS ALAMITOS BOULEVARD AT ROSSMOOR WAY

Product of Left-Turns and Opposing Through Movements	Peak Hour	Northbound			Southbound			Eastbound			Westbound		
		Left	Opposing Thru	**Product**	Left	Opposing Thru	**Product**	Left	Opposing Thru	**Product**	Left	Opposing Thru	**Product**
	AM	72	1337	**96,264**	33	1483	48,939	175	143	25,025	9	85	765
	PM	30	1757	52,710	95	1442	**136,990**	54	64	3,456	8	44	352

Traffic Volumes (continued)

In comparison to the California MUTCD, the guidelines given in the Highway Capacity Manual (HCM), 2010 edition, have minimum cross-products that are associated with the number of opposing through-lanes. The threshold set by the HCM establishes a minimum cross-product of 50,000 for left-turns opposed by one (1) through-lane, 90,000 when opposed by (2) lanes, and 110,000 with (3) opposing lanes. Similarly, it is shown from the table above that the southbound left-turn approach does meet the minimum product of 110,000 in the afternoon. It is common engineering practice to install left-turn phasing in both opposing directions, even if only one direction meets the guidelines, to provide consistency for drivers' expectations. Consequently, the traffic volumes do support the existing installation of fully-protected left-turn phasing on Los Alamitos Boulevard.

Miscellaneous

Speeds

As mentioned, Los Alamitos Boulevard has a posted speed limit of 40 MPH and an 85th percentile (critical) speed of 42.6 MPH ***(see Appendix D)***. These speeds correspond with speeds that may be expected on an urbanized three-lane arterial roadway. Although posted 40 MPH, it is not uncommon to find drivers travelling approximately 5 MPH over the speed limit. Consequently, a 45 MPH speed was also considered in this analysis.

Sight Distance

The geometry of the intersection is relatively flat and does not have horizontal and vertical roadway curvature to account for. It was found that the geometry presents a roadway intersection that does not need special traffic signal head locations for impaired visibility or advanced signage for overall improved sight distance. As Los Alamitos Boulevard is a truck route, buses and trucks were observed on Los Alamitos Boulevard; however, none were observed making left-turns at this residential intersection.

Miscellaneous (continued)

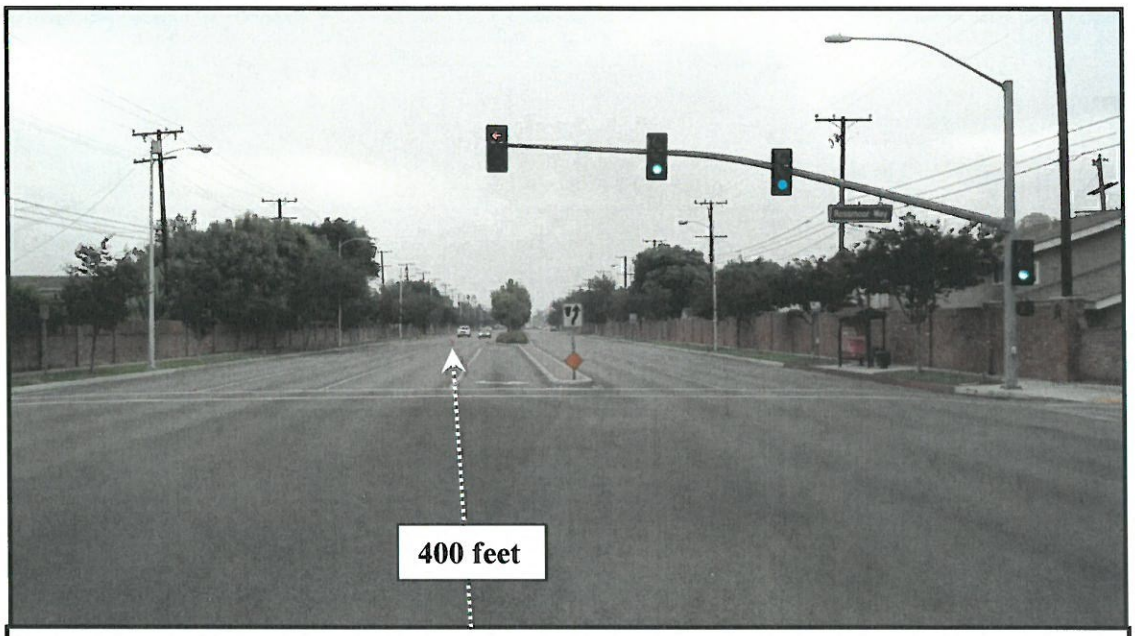
Sight Distance (cont'd)

Sight distance for the left-turning drivers was especially considered during our field-review of the surrounding urbanized residential environment. More specifically, a left-turning driver's sight distance, or visibility, was measured from a typical stopped-vehicle location in the northbound and southbound left-turn lanes. The measured distances were applied to the Stopping Sight Distance as a Function of Speed Guidelines found in the California MUTCD ***(see Appendix E)***. In these guidelines, roadway speeds of 40 and 45 MPH recommend a minimum Stopping Sight Distance of 305 and 360 feet, respectively. The HCM does not include guidelines on sight distance. The ITE guidelines state that restrictive sight distance is when there is less than 400 feet for roadway speeds of 40 MPH or more. As a result, 400 feet was used for sight distance.

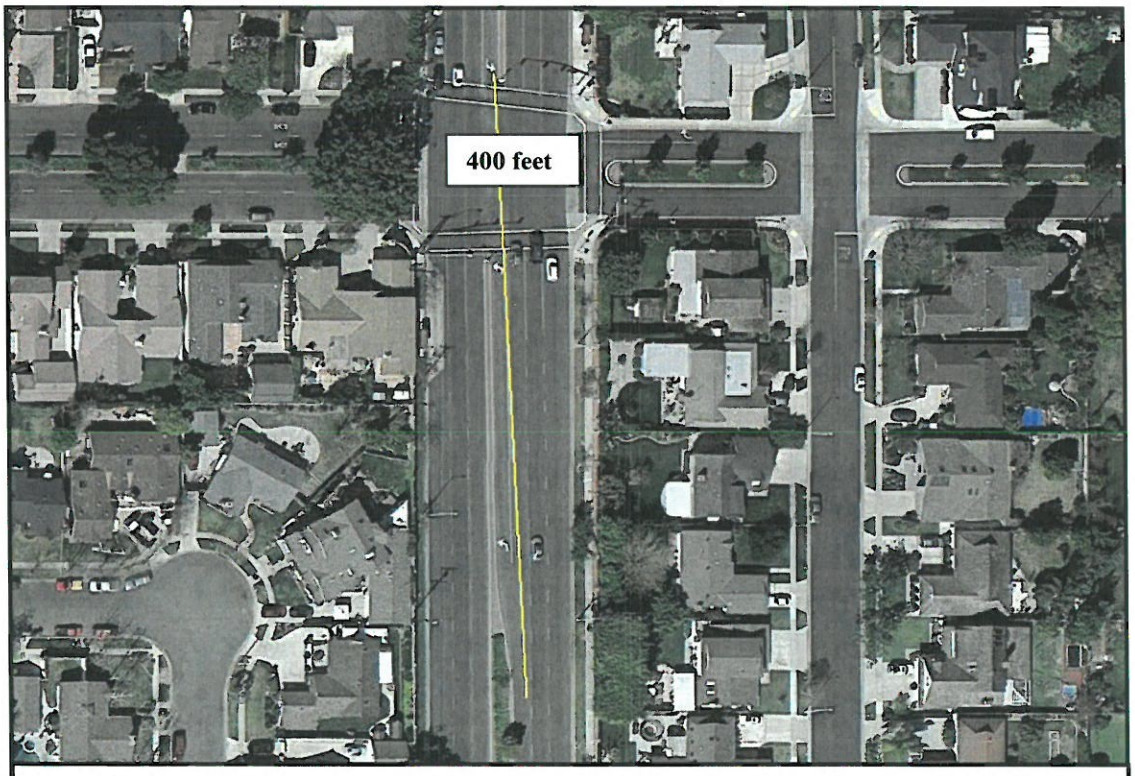
The 400-foot stopping sight distance was field-measured from a typical 'stopped' left-turning vehicle location looking towards the nearest lane of on-coming traffic. An orange cone was set on the lane line at this distance. As shown in Exhibits 3 and 4 on the next pages, a photograph was then taken from a left-turning driver's perspective in order to determine if a clear line of sight to the cone was met.

As can be seen, the field measurement for actual 'clear' sight distance for a southbound left-turning vehicle resulted in at least 400 feet. However, the field measurement for a northbound left-turning vehicle resulted in less than 400 feet due to a stopped left-turning vehicle in the opposing left-turn lane. Therefore, sight distance is considered restrictive for this particular left-turn movement as a driver cannot clearly see an oncoming vehicle in the nearest lane when a vehicle is in the opposing left-turn lane.

EXHIBIT 3



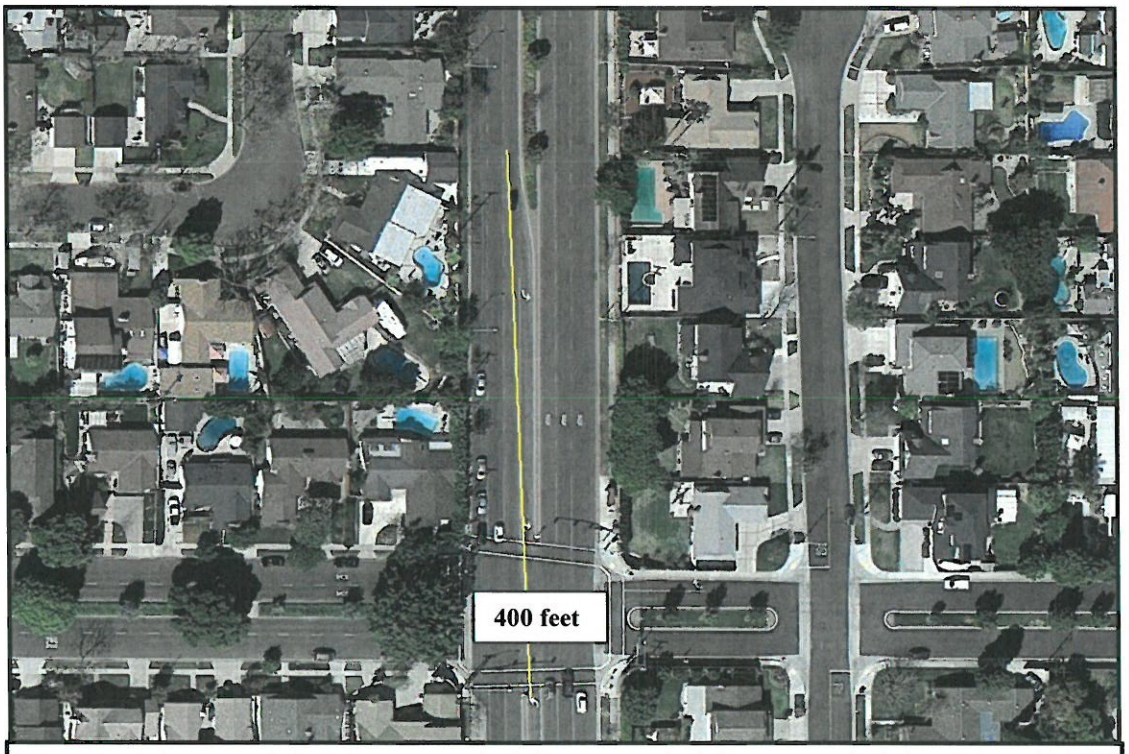
SB Los Alamitos Boulevard Looking at Oncoming NB Traffic



Aerial Image of SB Los Alamitos Boulevard Looking at Oncoming NB Traffic

EXHIBIT 4

NB Los Alamitos Boulevard Looking at Oncoming SB Traffic



Aerial Image of NB Los Alamitos Boulevard Looking at Oncoming SB Traffic

ANALYSIS SUMMARY

Based on collisions reported for the intersection during the past 10 years, only one was found to involve north and south left-turning movements. Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected that an increase in left-turn accidents may occur with protected-permissive left-turn phasing.

Based on the minimum traffic volume guidelines set forth in three references, this analysis showed that existing traffic volumes at this intersection (amount of left-turns and opposing through-movements) did satisfy the minimum volume guidelines for supporting the existing installation of protected left-turn phasing.

Engineering judgment should always be included in any decision regarding traffic improvements; as a result, the geometry of the intersection was noted as not having any horizontal and vertical curvature to consider. Upon field verification, it was found that this geometry presents a roadway intersection that does not need special traffic signal head locations or advanced signage for impaired sight distance or improving overall visibility.

Moreover, a driver's visibility was also checked from a typical stopped left-turning vehicle location on both northbound and southbound approaches. A 400-foot stopping sight distance was field-measured from these locations looking towards the nearest lane of on-coming traffic, and an orange cone was set on the lane line. A photograph was then taken from a driver's perspective in order to determine if a clear line of sight to the cone was met. The actual sight distance for a southbound left-turning vehicle resulted in at least 400 feet; however, the field measurement for a northbound left-turning vehicle resulted in less than 400 feet due to blocking by a stopped left-turning vehicle in the opposing left-turn lane. Therefore, sight distance is considered restrictive for this particular left-turn movement.

RECOMMENDATION

Based on the findings of this analysis, the installation of protected-permissive left-turn phasing is not recommended for the intersection of Los Alamitos Boulevard and Rossmoor Way due to the following reasons:

- There are sufficient traffic volumes that satisfy all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.
- Sight distance is considered restrictive for the northbound left-turning driver, as the actual sight distance measured to the nearest oncoming lane of traffic was less than 400 feet when a vehicle was in the opposing left-turn lane.
- There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers need to account for.
- Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, and one left-turn collision still occurred within the last 10 years, it can be expected that an increase in left-turn type accidents will occur if modified to protected-permissive.

APPENDIX A

LEFT-TURN PHASING GUIDELINES:

CALIFORNIA MUTCD,
HIGHWAY CAPACITY MANUAL,
and
ITE TRAFFIC ENGINEERING HANDBOOK

CALIFORNIA MUTCD

CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.

E. A supplementary sign shall not be required. ~~If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

06 The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

Section 4D.19 Signal Indications for Protected Only Mode Left-Turn Movements

Standard:

01 **A shared signal face shall not be used for protected only mode left turns unless the CIRCULAR GREEN and left-turn GREEN ARROW signal indications always begin and terminate together. If a shared signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-9):**

A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR GREEN, and left-turn GREEN ARROW. Only one of the three colors shall be displayed at any given time.

B. During the protected left-turn movement, the shared signal face shall simultaneously display both a CIRCULAR GREEN signal indication and a left-turn GREEN ARROW signal indication.

C. The shared signal face shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20).

Option:

02 A straight-through GREEN ARROW signal indication may be used instead of the CIRCULAR GREEN signal indication in Items A and B in Paragraph 1 on an approach where right turns are prohibited and a straight-through GREEN ARROW signal indication is also used instead of a CIRCULAR GREEN signal indication in the other signal face(s) for through traffic.

Standard:

03 **If a separate left-turn signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-10):**

A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a LEFT ON GREEN ARROW ONLY (R10-5) sign (see Figure 2B-27).

B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face that is used for the protected/permissive mode (see Section 4D.20 and Figures 4D-8 and 4D-12) except that the flashing left-turn YELLOW ARROW or flashing left-turn RED ARROW signal indication shall not be displayed when operating in the protected only mode.

Guidance:

04 *Since separate signal phases for protected left turns will reduce the green time available for other phases, alternate means of handling left turn conflicts should be considered first.*

Support:

05 The most likely possibilities are:

1. Prohibition of left turns. This can be done only if there are convenient alternate means of making the movement. Typical alternate means are:
   a. A series of right and/or left turns around a block to permit getting to the desired destination; or
   b. Making the left turn at an adjacent unsignalized intersection during gaps in the opposing through traffic.
2. Geometric changes to eliminate the left turn. An effective change would be a complete separation or a complete or partial "clover leaf" at grade. Any of these, while eliminating left turns, requires additional cost and right of way.
3. Provide protected-permissive or permissive-protected left turn operation. The protected left turn interval may be prohibited during certain periods of the day to allow only permissive intervals for left turn movement in order to increase the green time available for other phases. Refer to Section 4D.20 for the requirements of protected-permissive or permissive-protected left turn operation.

Guidance:

06 *Protected left turn phases should be considered where such alternatives couldn't be utilized, and one or more of the following conditions exist:*

1. *Collisions - Five or more left turn collisions for a particular left turn movement during a recent 12-month period.*
2. *Delay - Left-turn delay of one or more vehicles, which were waiting at the beginning of the green interval and are still remaining in the left turn lane after at least 80% of the total number of cycles for one hour.*
3. *Volume - At new intersections where only estimated volumes are available, the following criteria may be used. For pretimed signal or a background-cycle-controlled actuated signal, a left turn volume of more than two vehicles per approach per cycle for a peak hour; or for a traffic-actuated signal, 50 or more left turning vehicles per hour in one direction with the product of the turning and conflicting through traffic during the peak hour of 100,000 or more.*
4. *Miscellaneous. Other factors that might be considered include but are not limited to: impaired sight distance due to horizontal or vertical curvature, or where there are a large percentage of buses and trucks.*

Section 4D.20 Signal Indications for Protected/Permissive Mode Left-Turn Movements

Standard:

01 **If a shared signal face is provided for a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-11):**

A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR green, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three circular indications shall be displayed at any given time. Only one of the two arrow indications shall be displayed at any given time. If the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are always terminated together, the steady left-turn YELLOW ARROW signal indication shall not be required.

B. During the protected left-turn movement, the shared signal face shall simultaneously display a left-turn GREEN ARROW signal indication and a circular signal indication that is the same color as the signal indication for the adjacent through lane on the same approach as the protected left turn.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication, unless the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are being terminated together. When the left-turn GREEN ARROW and CIRCULAR GREEN signal indications are being terminated together, the required display following the left-turn GREEN ARROW signal indication shall be either the display of a CIRCULAR YELLOW signal indication alone or the simultaneous display of the CIRCULAR YELLOW and left-turn YELLOW ARROW signal indications.

D. During the permissive left-turn movement, the shared signal face shall display only a CIRCULAR GREEN signal indication.

E. A protected/permissive shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

F. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign (see Figure 2B-27).

02 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.**

03 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-12):**

A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.

B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

D. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.

E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.

F. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.

G. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn YELLOW ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn YELLOW ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.

H. The display shall be a four-section signal face except that a three-section signal face containing a dual-arrow signal section shall be permitted where signal head height limitations (or lateral positioning limitations for a horizontally-mounted signal face) will not permit the use of a foursection signal face. The dual-arrow signal section, where used, shall display a GREEN ARROW for the protected left-turn movement and a flashing YELLOW ARROW for the permissive left-turn movement.

I. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.

J. During flashing mode operation (see Section 4D.30), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.

Option:

04 A separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.

Standard:

05 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-8):**

A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.

B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

D. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed.

E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.

F. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn RED ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn RED ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.

G. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.

H. A supplementary sign shall not be required. ~~If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

06 The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

Standard:

07 **Protected/permissive mode left-turn shall not be used for left turn movements that oppose phases that require preemption for rail traffic.**

Section 4D.21 Signal Indications for Right-Turn Movements – General

Standard:

01 **In Sections 4D.21 through 4D.24, provisions applicable to right-turn movements and right-turn lanes shall also apply to signal indications for U-turns to the right that are provided at locations where right turns are prohibited or not geometrically possible.**

Support:

02 Right-turning traffic is controlled by one of four modes as follows:

A. Permissive Only Mode—turns made on a CIRCULAR GREEN signal indication, a flashing right-turn YELLOW ARROW signal indication, or a flashing right-turn RED ARROW signal indication after yielding to pedestrians, if any.

B. Protected Only Mode—turns made only when a right-turn GREEN ARROW signal indication is displayed.

C. Protected/Permissive Mode—both modes occur on an approach during the same cycle.

D. Variable Right-Turn Mode—the operating mode changes among the protected only mode and/or the protected/permissive mode and/or the permissive only mode during different periods of the day or as traffic conditions change.

Standard:

03 **During a permissive right-turn movement, the signal faces, if any, that exclusively control U-turn traffic that conflicts with the permissive right-turn movement (see Item F.1 in Section 4D.05) shall simultaneously display steady U-turn RED ARROW signal indications. If pedestrians crossing the lane or lanes used by the permissive right-turn movement to depart the intersection are controlled by pedestrian signal heads, the signal indications displayed by those pedestrian signal heads shall not be limited to any particular display during the permissive right-turn movement.**

04 **During a protected right-turn movement, the signal faces for left-turn traffic, if any, on the opposing approach shall not simultaneously display a steady left-turn GREEN ARROW or steady left-turn**

HIGHWAY CAPACITY MANUAL

Exhibit 31-38
Quick Estimation Left-Turn Treatment Worksheet

QUICK ESTIMATION LEFT-TURN TREATMENT WORKSHEET

General Information

Description Intersection of Los Alamitos Blvd. at Rossmoor Way

Check # 1. Left-Turn Lane Check

Approach	EB	WB	NB	SB
Number of left-turn lanes	1	Ø	1	1
Protect left turn (Y or N)?	N	N	N	N

If the number of left-turn lanes on any approach exceeds 1, then it is recommended that the left turns on that approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.

Check # 2. Minimum Volume Check

Approach	EB	WB	NB	SB
Left-turn volume	175	9	72	95
Protect left turn (Y or N)?	N	N	N	N

If left-turn volume on any approach exceeds 240 veh/h, then it is recommended that the left turns on that approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.

Check # 3. Minimum Cross-Product Check

Approach	EB	WB	NB	SB
Left-turn volume, V_L (veh/h)	175	9	72	95
Opposing mainline volume, V_o (veh/h)	143	85	1337	1442
Cross-product (V_L * V_o)	25,025	765	96,264	136,990
Opposing through lanes	2	2	3	3
Protected left turn (Y or N)?	N	N	N/Y	Y

Minimum Cross-Product Values for Recommending Left-Turn Protection

Number of Through Lanes	Minimum Cross-Product
1	50,000
2	90,000
3	110,000

If the cross-product on any approach exceeds the above values, then it is recommended that the left turns on that approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.

Check # 4. Sneaker Check

Approach	EB	WB	NB	SB
Left-turn volume, V_L (veh/h)	175	9	72	95
Sneaker capacity, c_s (veh/h) c_s = 7200/C	60	60	60	60
Equivalence factor, E_{L1}	1.5	1.4	>4.0	>4.0
Protected left turn (Y or N)?	N	N	Y	Y

If the equivalence factor is 3.5 or higher (computed in the Quick Estimation Lane Volume Worksheet) and the unadjusted left turn is greater than the sneaker capacity, then it is recommended that the left turns on that approach be protected.

Notes

1. If any approach is recommended for left-turn protection but the analyst evaluates it as having permitted operation, then this quick estimation method may give overly optimistic results. The analyst should instead use the methodology described in Chapter 18, Signalized Intersections.
2. All volumes used in this worksheet are unadjusted hourly volumes.

Step 2: Determine Lane Volume

The lane volume worksheet is shown in Exhibit 31-39. Its purpose is to establish the individual lane flow rate (in veh/h/ln) on each intersection approach. This information is then used in the control delay and level-of-service worksheet to synthesize the signal-timing plan. The directional designations (e.g., RT = right turn, LT = left turn) refer to the traffic movements as they approach the intersection.

The number of through lanes N_{TH} includes any lane that serves through vehicles. Exclusive turn lanes should be excluded.

For an unopposed shared lane, the total approach volume V_{tot} is the sum of the shared-lane right-turn volume, through volume, and left-turn volume.

D. Compute Lane Volume for Through Movement with Exclusive Turn Lane

For approaches with an exclusive left-turn lane (or lanes), the through-lane volume V_{TH} is computed by dividing total approach volume by the number of through lanes.

The critical lane volume V_{CL} is normally the same as the through-lane volume, unless the right turn has an exclusive lane or the left turn is not opposed and either of these movements is more critical than the through movement. If both conditions apply, the critical lane volume will be the largest of the left-lane volume, exclusive right-lane volume, and through-lane volume.

E. Compute Lane Volume for Through Movement with Shared Lane

The computation of critical lane volume in the case of shared left-turn lanes is more complicated and requires a more detailed computational procedure. The equivalence factor E_{L1} for a permitted left turn is obtained from Exhibit 31-40 or computed with Equation 31-152.

Exhibit 31-40
Through-Car Equivalents for Permitted Left Turns

Type of Left-Turn Lane	Through-Car Equivalent E_{L1} as a Function of Opposing Flow Rate (veh/h)						
	1	200	400	600	800	1,000	1,200[a]
Shared	1.4	1.7	2.1	2.5	3.1	3.7	4.5
Exclusive	1.3	1.6	1.9	2.3	2.8	3.3	4.0

Note: [a] Use Equation 31-152, with Equation 31-153, for opposing flow in excess of 1,200 veh/h; v_o must be ≥ 0.1 veh/h.

Equation 31-152

$$E_{L1} = \frac{s_o}{s_p} - I_{sh}$$

with

Equation 31-153

$$s_p = \frac{v_o \, e^{-v_o \, t_{cg} / 3{,}600}}{1 - e^{-v_o \, t_{fh} / 3{,}600}}$$

where

E_{L1} = equivalent number of through cars for a permitted left-turning vehicle,

s_o = base saturation flow rate (pc/h/ln),

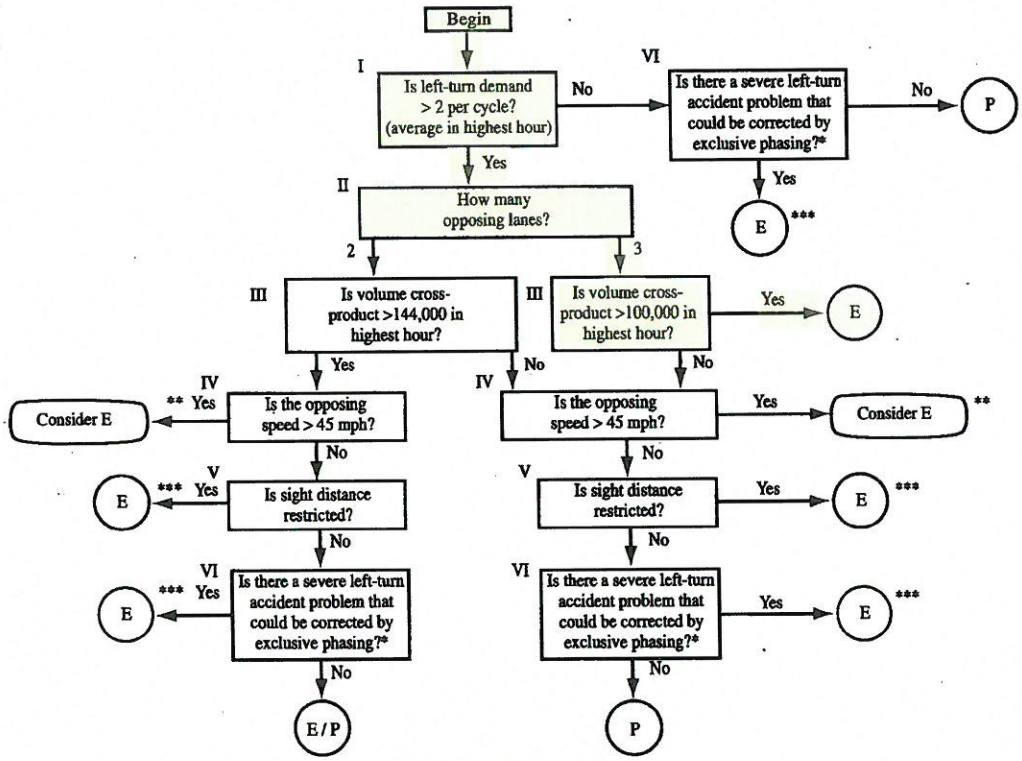
s_p = saturation flow rate of a permitted left-turn movement (veh/h/ln),

I_{sh} = indicator variable for shared lane (= 1.0 if the subject left turn is served in a shared lane, 0 if the subject left turn is served in an exclusive lane),

v_o = opposing demand flow rate (veh/h),

t_{cg} = critical headway = 4.5 (s), and

ITE TRAFFIC ENGINEERING HANDBOOK



P – Permissive

E/P – Exclusive/Permissive

E – Exclusive

Note: This procedure applies to locations with a separate left-turn lane.

Restrictive Sight Distance is:

< 250 ft when speeds are 35 mph or less;

< 400 ft when speeds are 40 mph or more.

* See text for definition of severe left-turn accident problem.

** An opposing speed > 45 mph indicates a potential left-turn accident problem. Consider exclusive phasing, realizing that non-left-turn accidents may increase.

*** Use exclusive phasing with the understanding that non-left-turn accidents may increase.

Figure 13–7 Recommended Procedure for Determining Type of Left-Turn Phasing

Source: J.E. Upchurch, "Guidelines for Selecting Type of Left-Turn Phasing," *Traffic Control Devices and Rail-Highway Crossings,* Transportation Research Record 1069, Washington, D.C.: Transportation Research Board, National Research Council, 1986, p. 30.

The University of Texas at Arlington has developed guidelines for left-turn phasing based on research, actual field data, easy-to-use quantitative measures, and statistical analysis of most suitable left-turn options. The process favors the least restrictive option—permitted left-turn—unless traffic and geometrics warrant a more restrictive control.[16] The decisions to be made are classified into three levels summarized as follows and shown in Figure 13–8.

Level 1: Permissive-Only Versus Some Protection

The permissive option should be used only if all of the following conditions exist:

[16] S.A. Asante, S.A. Ardekani, and J.C. Williams, "Selection Criteria for Left-Turn Phasing and Indication Sequence," *Traffic Control Devices, Visibility, and Traffic Signal Systems,* Transportation Research Record 1421 (Washington, D.C.: Transportation Research Board, National Research Council, 1993), p. 11.

APPENDIX B

INTERSECTION COLLISION HISTORY DATA

CITY OF LOS ALAMITOS
SWITRS COLLISION HISTORY 2001 TO 2011
INTERSECTION OF LOS ALAMITOS BLVD AND ROSSMOOR WAY

CASE ID	COLLISION DATE	COLL. TIME	PRIMARY ROAD	SECONDARY ROAD	DISTANCE	DIRECTION	INTERSECTION	WEATHER 1	COLLISION SEVERITY	PRIMARY COLL FACTOR	PCF VIOL CAT.	HIT AND RUN	TYPE OF COLL.	MOTOR VEHICLE INVOLVED WITH	ROAD SURF.
3013010227205600000	20010227	2056	LOS ALAMITOS BL	ROSSMOOR WY	0	-	Y	C	0	A	1	N	C	C	B
3013010717155700000	20010717	1557	LOS ALAMITOS BL	ROSSMOOR WY	79	S	N	A	4	C	18	N	C	C	A
3013011206080100000	20011206	801	LOS ALAMITOS BL	ROSSMOOR WY	0	-	Y	A	3	A	12	N	D	C	A
25651	20020116	1609	LOS ALAMITOS BL	ROSSMOOR WY	34	N	N	A	0	A	3	N	C	C	A
181204	20020416	838	LOS ALAMITOS BL	ROSSMOOR WY	34	N	N	A	0	D	0	M	C	C	A
468472	20021021	1008	LOS ALAMITOS BL	ROSSMOOR WY	29	S	N	A	0	A	3	N	C	C	A
529848	20021115	1439	LOS ALAMITOS BL	ROSSMOOR WY	13	N	N	A	0	A	3	N	C	C	A
541423	20021202	1146	LOS ALAMITOS BL	ROSSMOOR WY	31	S	N	A	0	A	12	N	D	C	A
661736	20030211	1517	LOS ALAMITOS BL	ROSSMOOR WY	53	S	N	B	0	C	18	N	C	C	B
912863	20030712	1203	LOS ALAMITOS BL	ROSSMOOR WY	39	N	N	A	4	A	3	N	C	C	A
1184198	20031206	1836	LOS ALAMITOS BL	ROSSMOOR WY	0		Y	A	4	A	12	N	D	C	A
1455789	20040515	1342	LOS ALAMITOS BL	ROSSMOOR WY	27	N	N	A	0	A	3	N	C	C	A
1513518	20040616	1251	LOS ALAMITOS BL	ROSSMOOR WY	25	S	N	A	0	A	3	N	C	C	A
1555507	20040722	1358	LOS ALAMITOS BL	ROSSMOOR WY	75	S	N	A	0	A	17	N	C	C	A
1603451	20040831	1717	LOS ALAMITOS BL	ROSSMOOR WY	46	N	N	A	4	A	3	N	C	C	A
2136125	20050716	225	LOS ALAMITOS BL	ROSSMOOR WY	55	S	N	A	0	A	1	M	C	C	A
2276781	20051004	740	LOS ALAMITOS BL	ROSSMOOR WY	0		Y	A	4	A	10	N	D	G	A
2662767	20060603	2255	LOS ALAMITOS BL	ROSSMOOR WY	29	N	N	A	0	A	1	N	C	C	A
9000977	20060819	2306	LOS ALAMITOS BL	ROSSMOOR WY	0		Y	A	4	A	9	F	D	C	A
3284081	20070719	944	LOS ALAMITOS BL	ROSSMOOR WY	0		Y	A	0	A	3	N	C	C	A
3377056	20070915	2140	LOS ALAMITOS BL	ROSSMOOR WY	25	N	N	A	4	A	8	N	E	I	A
3866731	20080809	2011	LOS ALAMITOS BL	ROSSMOOR WY	29	N	N	A	0	A	1	M	E	I	A
4918217	20100930	1930	LOS ALAMITOS BL	ROSSMOOR WY	28	N	N	A	3	A	1	N	C	I	A
4984372	20101129	1834	LOS ALAMITOS BL	ROSSMOOR WY	20	S	N	A	0	A	1	N	C	C	C

CITY OF LOS ALAMITOS
SWITRS COLLISION HISTORY 2001 TO 2011
INTERSECTION OF LOS ALAMITOS BLVD AND ROSSMOOR WAY

NOTES:

Weather 1

A - Clear
B - Cloudy
C - Raining
D - Snowing
E - Fog
F - Other
G - Wind
- - Not Stated

Collision Severity

1 - Fatal
2 - Injury (Severe)
3 - Injury (Other Visible)
4 - Injury (Complaint of Pain)
0 - PDO (Property Damage Onl

Primary Collision Factor

A - (Vehicle) Code Violation
B - Other Improper Driving
C - Other Than Driver
D - Unknown
E - Fell Asleep
- - Not Stated

PCF Violation Category

01 - Driving or Bicycling Under Influence
02 - Impeding Traffic
03 - Unsafe Speed
04 - Following Too Closely
05 - Wrong Side of Road
06 - Improper Passing
07 - Unsafe Lane Change
08 - Improper Turning
09 - Automobile ROW
10 - Pedestrian ROW
11 - Pedestrian Violation
12 - Traffic Signals and Signs
13 - Hazardous Parking
14 - Lights
15 - Brakes
16 - Other Equipment
17 - Other Hazardous Violation
18 - Other Than Driver (or Ped)
19 -
20 -
21 - Unsafe Starting or Backing
22 - Other Improper Driving
23 - Pedestrian or "Other" Under the Influence
24 - Fell Asleep
00 - Unknown
- - Not Stated

Hit and Run

F - Felony
M - Misdemeanor
N - Not Hit & Run

Type of Collision

A - Head-On
B - Sideswipe
C - Rear-End
D - Broadside
E - Hit Object
F - Overturned
G - Vehicle/Pedestrian
H - Other
- - Not Stated

Motor Vehicle Involved With:

A - Non-Collision
B - Pedestrian
C - Other Motor Vehicle
D - Motor Vehicle on Other Roadway
E - Parked Motor Vehicle
F - Train
G - Bicycle
H - Animal
I - Fixed Object
J - Other Object
- - Not Stated

Road Surface

A - Dry
B - Wet
C - Snowy or Icy
D - Slippery
- - Not Stated

APPENDIX C

PEAK-HOUR TURNING MOVEMENT

TRAFFIC VOLUME DATA

ITM Peak Hour Summary

Prepared by:

NDS

National Data & Surveying Services

Los Alamitos Blvd and Rossmoor Way , City of Los Alamitos

Date: 9/18/2012

Day: Tuesday

Project #: CA12_1195_001

AM Peak Hour	715 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (Los Alamitos Blvd)

Lanes	0	3	1		
AM	100	1237	33	1761	AM
NOON	0	0	0	0	NOON
PM	59	1698	95	1542	PM

Eastbound Approach (Rossmoor Way)

	AM	NOON	PM
	205	0	94
0	175	0	54
2	19	0	8
0	66	0	36
Lanes	AM	NOON	PM

Westbound Approach

	AM	NOON	PM	Lanes
	110	0	59	1
	33	0	5	1
	9	0	8	0
	59	0	116	
	AM	NOON	PM	

Northbound Approach

AM	1312	72	1476	7	AM
NOON	0	0	0	0	NOON
PM	1742	30	1429	13	PM
		1	3	0	Lanes

CONTROL

Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	6:00 PM

Total Ins & Outs

	North Leg		
AM	1370	1761	AM
NOON	0	0	NOON
PM	1852	1542	PM

West Leg	AM	NOON	PM
	205	0	94
	260	0	98

East Leg	AM	NOON	PM
	152	0	72
	59	0	116

South Leg		
AM	1312	1555
NOON	0	0
PM	1742	1472

Total Volume Per Leg

North Leg	
AM	3131
NOON	0
PM	3394

West Leg	AM	NOON	PM
	465	0	192

East Leg	AM	NOON	PM
	211	0	188

South Leg	
AM	2867
NOON	0
PM	3214

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: CA12_1195_001

Day: TUESDAY

City: City of Los Alamitos

Date: 9/18/2012

AM

NS/EW Streets:	Los Alamitos Blvd			Los Alamitos Blvd			Rossmoor Way			Rossmoor Way			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	1	3	0	0	2	0	0	1	1	
7:00 AM	10	300	3	8	174	10	20	1	11	2	3	28	570
7:15 AM	12	422	2	7	241	16	26	0	9	4	6	38	783
7:30 AM	29	358	0	8	313	35	32	1	8	2	11	24	821
7:45 AM	26	354	2	9	384	39	59	8	24	3	13	26	947
8:00 AM	5	342	3	9	299	10	58	10	25	0	3	22	786
8:15 AM	3	362	1	6	221	8	23	0	12	0	1	23	660
8:30 AM	4	317	1	9	237	9	22	0	10	3	0	12	624
8:45 AM	3	261	3	13	236	10	8	0	4	0	0	21	559
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	92	2716	15	69	2105	137	248	20	103	14	37	194	5750
APPROACH %'s :	3.26%	96.21%	0.53%	2.99%	91.09%	5.93%	66.85%	5.39%	27.76%	5.71%	15.10%	79.18%	
PEAK HR START TIME :	715 AM												TOTAL
PEAK HR VOL :	72	1476	7	33	1237	100	175	19	66	9	33	110	3337
PEAK HR FACTOR :		0.892			0.793			0.699			0.792		0.881

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: CA12_1195_001 **Day:** TUESDAY

City: City of Los Alamitos **Date:** 9/18/2012

PM

NS/EW Streets:	Los Alamitos Blvd			Los Alamitos Blvd			Rossmoor Way			Rossmoor Way			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	1	3	0	0	2	0	0	1	1	
4:00 PM	7	314	3	17	314	17	15	6	13	1	2	18	727
4:15 PM	9	323	2	21	316	22	8	5	7	2	3	17	735
4:30 PM	9	354	3	20	400	11	12	6	8	2	2	15	842
4:45 PM	3	373	3	19	412	14	14	2	9	2	2	20	873
5:00 PM	12	345	6	32	427	16	16	3	10	1	0	8	876
5:15 PM	5	352	1	22	433	16	16	1	7	2	3	16	874
5:30 PM	10	359	3	22	426	13	8	2	10	3	0	15	871
5:45 PM	14	357	3	23	361	11	11	2	13	3	0	15	813
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	69	2777	24	176	3089	120	100	27	77	16	12	124	6611
APPROACH %'s :	2.40%	96.76%	0.84%	5.20%	91.26%	3.55%	49.02%	13.24%	37.75%	10.53%	7.89%	81.58%	
PEAK HR START TIME :	445 PM												TOTAL
PEAK HR VOL :	30	1429	13	95	1698	59	54	8	36	8	5	59	3494
PEAK HR FACTOR :		0.971			0.975			0.845			0.750		0.997

CONTROL : Signalized

APPENDIX D

ENGINEERING AND TRAFFIC SURVEY

FOR

LOS ALAMITOS BOULEVARD

CITY OF LOS ALAMITOS

ENGINEERING AND TRAFFIC SURVEY
FIELD REVIEW FORM

LOS ALAMITOS BOULEVARD — **FARQUHAR AVENUE TO BRADBURY ROAD**

FIELD REVIEW BY: C. BUENDIA — CHECKED BY: JERRY STOCK — DATE: 5/12/03

FACTORS	DIRECTION: NORTHBOUND	DIRECTION: SOUTHBOUND
A. PREVAILING SPEED DATA		
DATE OF SURVEY	05/12/03	05/12/03
LOCATION OF SURVEY	NORTH OF BRADBURY	NORTH OF BRADBURY
85TH PERCENTILE	42.6 MPH	42.6 MPH
10 MPH PACE	35 - 44 MPH	34 - 43 MPH
PERCENT IN PACE	66.9 %	71.8 %
POSTED SPEED LIMIT	40 MPH / 25 MPH**	40 MPH / 25 MPH**
B. ACCIDENT HISTORY		
NO. OF MONTHS COVERED	36	36
SPEED-RELATED ACCIDENTS	1	0
TOTAL ACCIDENTS	5	0
ANNUAL ACCIDENT RATE	0.33 ACCIDENTS PER YEAR (SPEED ONLY)	0.00 ACCIDENTS PER YEAR (SPEED ONLY)
ACCIDENTS/MIL. VEH. MILES	0.05 ACCIDENTS PER MVM (SPEED ONLY)	0.00 ACCIDENTS PER MVM (SPEED ONLY)
C. TRAFFIC FACTORS		
AVERAGE DAILY TRAFFIC	21,150	21,150
LANE CONFIGURATION	3 LANES	3 LANES
TRAFFIC CONTROLS	SIGNAL - FARQUHAR / ORANGEWOOD & >	AND SIGNAL - ROSSMOOR / BRADBURY
CROSSWALKS	AT SIGNALS	AT SIGNALS
PEDESTRIAN/BICYCLES	YES / YES	YES / YES
TRUCK TRAFFIC	YES	YES
ON-STREET PARKING	NO PARKING ANYTIME	NO PARKING ANYTIME
OTHER (SPECIFY)		
D. ROADWAY FACTORS		
LENGTH OF SEGMENT (MILES)	0.81	0.81
VERTICAL CURVE	NONE	NONE
HORIZONTAL CURVE	NONE	NONE
LATERAL VISIBILITY	GOOD	GOOD
SURFACE CONDITION	GOOD	GOOD
SIDEWALKS/DRIVEWAYS	YES / YES	YES / NO
STREET LIGHTING	YES	YES
DRIVEWAY DENSITY	LIGHT	NONE
OTHER (SPECIFY)		
E. ADJACENT LAND USES	COMMERCIAL / BUSINESS / RES / CHURCH	RESIDENTIAL
RECOMMENDED SPEED LIMIT	40 MPH	40 MPH
SPEED LIMIT CHANGE?	NO	NO

** 25 MPH WHEN CHILDREN PRESENT, SCHOOL ZONE

APPENDIX E

STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED

CALIFORNIA MUTCD

Table 6C-1. Recommended Advance Warning Sign ~~Minimum~~ Spacing

Road Type	Distance Between Signs*		
	A	B	C
Urban (low speed) - 25 mph or less	100 feet	100 feet	100 feet
Urban (high speed) - more than 25 mph to 40 mph	250 feet	250 feet	250 feet
Urban (high speed) - more than 40 mph	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

* ~~Speed category to be determined by the highway agency.~~
** The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

Table 6C-2. Stopping Sight Distance as a Function of Speed

Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed.
Can also be used as Stopping Sight Distance as suggested buffer space length or location for flagger station.

Table 6C-3. Taper Length Criteria for Temporary Traffic Control Zones

Type of Taper	Taper Length
Merging Taper	at least L
Shifting Taper	at least 0.5 L
Shoulder Taper	at least 0.33 L
One-Lane, Two-Way Traffic Taper	50 feet minimum, 100 feet maximum
Downstream Taper	50 feet minimum, 100 feet maximum

Note: Use Table 6C-4 to calculate L

HARTZOG & CRABILL, Inc.

Trammell Hartzog, President
Jerry Crabill, P.E. (Retired)
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Suite 101
Tustin, CA 92780

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www.hartzog-crabill.com

November 13, 2012

Mr. Dave Hunt, P.E.
Director of Public Works/City Engineer
City of Los Alamitos
3191 Katella Avenue
Los Alamitos, CA 90720

Subject: Left-Turn Phasing Analysis at the Intersection of Los Alamitos Boulevard and Bradbury Road

Dear Mr. Hunt:

Hartzog & Crabill, Inc. (HCI) has completed a Left-Turn Phasing Warrant Analysis for the subject intersection. As you will see in the attached report, the findings of this study show that the modification from protected to protected-permissive left-turn phasing on Los Alamitos Boulevard is not recommended for this intersection.

The analysis was completed in response to the City's request to verify if protected-permissive left-turn phasing is warranted, and recommended based on meeting standard guidelines. At the present time, the intersection is signalized with a 5-phase operation with protected left-turn phasing on Los Alamitos Boulevard. The California Manual of Uniform Traffic Control Devices (*California MUTCD*) was used for defining the requirements for left-turn phasing, as well as the Highway Capacity Manual (*HCM*) and Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. Based on these guidelines, there are four conditions considered for left-turn phasing: 1) Accident History; 2) Delay; 3) Traffic Volumes; and 4) Miscellaneous (*i.e., impaired sight distance, roadway curvature, etc.*).

Based on the findings of our analysis, the installation of protected-permissive left-turn phasing is not recommended due to the following reasons:

- There were sufficient traffic volumes that met all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.
- There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers would need to account for under the 'permissive' portion.
- Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected left-turn type accidents may occur if modified to protected-permissive.

It has been our pleasure to prepare this analysis for the City of Los Alamitos. If you have any questions or need more information please call (714) 731-9455.

Regards,
HARTZOG & CRABILL, INC.

Mark J. Esposito

Mark J. Esposito, PE, TE, PTOE
Project Manager

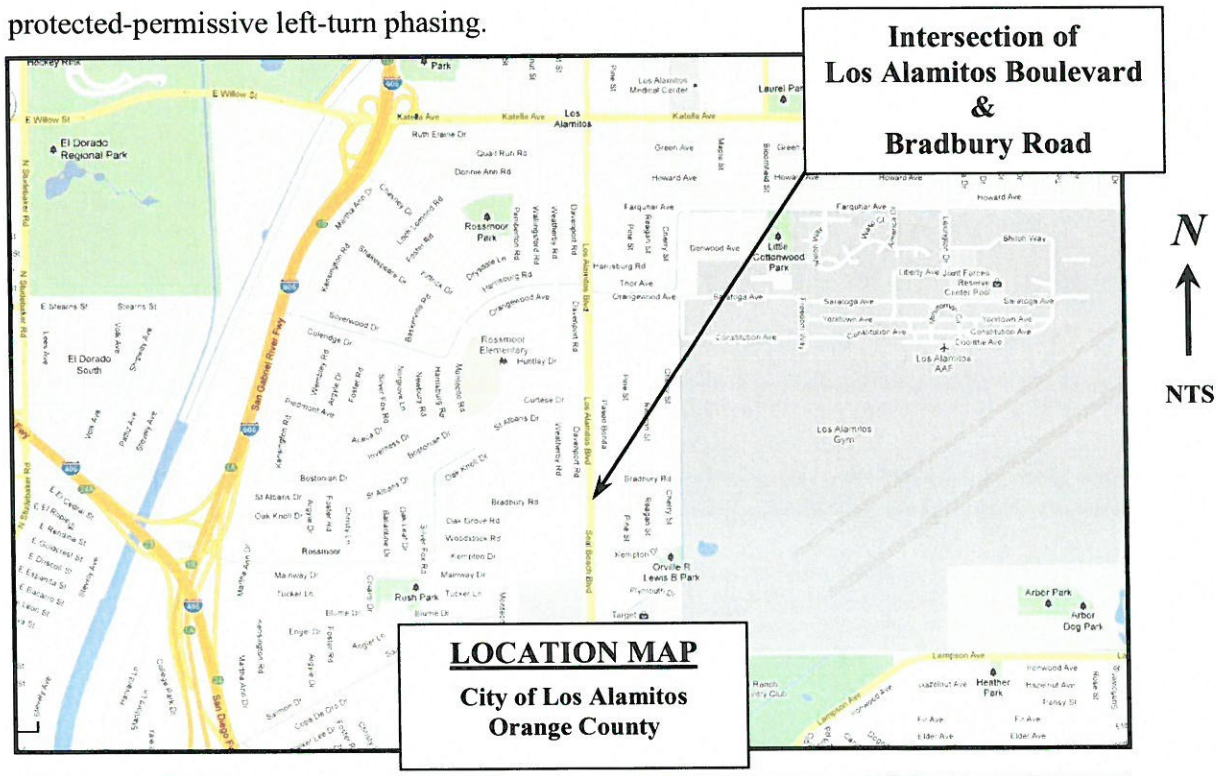
Attach: Left-Turn Phasing Analysis Report

LEFT-TURN PHASING ANALYSIS:

INTERSECTION OF
LOS ALAMITOS BOULEVARD AND BRADBURY ROAD
IN THE CITY OF LOS ALAMITOS, CA

INTRODUCTION

The City of Los Alamitos requested Hartzog & Crabill, Inc. (HCI) to complete a Left-Turn Phasing Warrant Analysis at the intersection of Los Alamitos Boulevard and Bradbury Road. This analysis was completed in order to verify if protected-permissive left-turn phasing is warranted for the left-turns on Los Alamitos Boulevard onto Bradbury Road, and recommended based on meeting standard guidelines. The location is a residential/commercial intersection with Los Alamitos Boulevard running in the north-south directions and Bradbury Road in the east-west directions. The intersection is located east of the I-605 Freeway, and south of Katella Avenue (*see Location Map below*). Presently, the intersection is signalized with a 5-phase operation, with protected left-turn phasing on the northbound and southbound approaches. This analysis will study if the protected left-turn phasing on Los Alamitos Boulevard may be modified to protected-permissive left-turn phasing.



BACKGROUND

Los Alamitos Boulevard is a north-south major arterial roadway. At the intersection with Bradbury Road, the roadway has residential properties on both sides, commercial properties on the southwest corner, and a street width of approximately 90 feet. The painted striping provides for three through lanes of traffic with a dedicated left-turn lane for each direction. There is a raised landscaped median on the north leg of Los Alamitos Boulevard, and curb, gutter, and sidewalk improvements along both sides of the roadway. Los Alamitos Boulevard has a posted speed limit of 40 MPH on the north leg and 45 MPH on the south leg. The street name changes south of this intersection to Seal Beach Boulevard. On-street parking is restricted on both sides of the road with No Stopping Any Time signs. Currently, the traffic signal provides for protected left-turn phasing on Los Alamitos Boulevard when turning left onto Bradbury Road.

See Exhibit 1 (next page) for photo images of Los Alamitos Boulevard.

Bradbury Road is a residential roadway that has a street width of approximately 60 feet. The striping provides for a single lane of traffic in each direction. The directions on the east leg are separated by a raised landscaped median. There are curb, gutter, and sidewalk improvements along both sides of Bradbury Road, which has a posted speed limit of 25 MPH. On-street parking is allowed on both sides of the roadway, with exception to some red curb on the east leg near the intersection. Currently, the traffic signal provides for permissive phasing on Bradbury Road when turning left onto Los Alamitos Boulevard.

See Exhibit 2 (following page) for photo images of Bradbury Road.

EXHIBIT 1

Seal Beach Boulevard (*Looking Northbound*) @ Bradbury Road

Los Alamitos Boulevard (*Looking Southbound*) @ Bradbury Road

EXHIBIT 2

Bradbury Road (*Looking Eastbound*) @ Los Alamitos Boulevard

Bradbury Road (*Looking Westbound*) @ Los Alamitos Boulevard

LEFT-TURN PHASING ANALYSIS

The approach for this analysis follows typical left-turn phasing warrant studies (i.e., analysis of warrants for protected left-turn phasing when only permissive phasing exists). However, as the intersection already has protected left-turn phasing, particular guidelines will be focused on and under careful consideration to help determine if the possible modification to protected-permissive is recommended or not.

As is common practice with many municipal agencies, the City of Los Alamitos has an adopted practice for using State guidelines as reference standards in order to provide uniformity and consistency in terms of traffic control. Therefore, the following three prevailing sources that address this topic were considered: 1) State of California Manual of Uniform Traffic Control Devices (*California MUTCD*); 2) State of California Highway Capacity Manual (*HCM*); as well as 3) Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. These sources were referenced because some diversity exists between them regarding left-turn phasing guidelines ***(see Appendix A for all three applicable guidelines)***.

Based on the comprehensive State guidelines found in the California MUTCD, which are most-typically referenced, there are four conditions that are considered for left-turn phasing: 1) Accident History; 2) Volume; 3) Delay; and 4) Miscellaneous. If any one of these conditions is met, then protected left-turn phasing should be considered.

Accident history, traffic volume data, and sight distance (visibility) are the conditions most often studied by HCI for this type of analysis, since they provide a good overall picture of the intersection characteristics. Consequently, the following analysis has focused on these three conditions to determine if protected-permissive left-turn phasing is warranted and recommended for the northbound and southbound approaches of Los Alamitos Boulevard.

Accident History

The guidelines for left-turn phasing contained in the California MUTCD regarding accidents require a minimum of five (5) left-turn collisions for a particular left-turn movement during a recent 12-month period. The HCM does not include guidelines on collisions; however, the ITE guidelines do call for a minimum of (8) left-turn-related accidents occurring within the last three years at any one approach with permissive-only phasing.

In recognition that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected that there may be no (or minimal) left-turn type accidents. Typically, left-turn type accidents are categorized as 'Broadside' or 'Head-On'. If there are a considerable amount of these types of accidents still occurring, then the finding may not support modification to protected-permissive left-turn phasing.

The available accident history reported for the intersection was gathered from the California Highway Patrol Statewide Integrated Traffic Records System (SWITRS). More specifically, a comprehensive 10-year traffic collision history summary report was prepared and reviewed for any left-turn type collisions (***attached in Appendix B)***.

As shown in the summary report, there were a total of (9) collisions reported at or near this intersection between years 2001 and 2011. Of these, none were found involving north-south left-turning movements at the intersection. Therefore, protected-permissive left-turn phasing may be further considered, if other factors such as 'less than minimum' traffic volumes and adequate sight distance support it as well.

Traffic Volumes

Again, recognizing that this intersection already has protected left-turn phasing on Los Alamitos Boulevard, it can be expected that minimum left-turn traffic volumes are met for this installation. If the minimum left-turn volume guidelines are not reached, the finding may further support modification to protected-permissive left-turn phasing.

Traffic Volumes (continued)

As stated in the California MUTCD and noted below, protected left-turn phasing should be considered when the following left-turn traffic volume criteria are met:

> ***For a pretimed signal or a background-cycle-controlled actuated signal, a left turn volume of more than two vehicles per approach per cycle for a peak hour; or for a traffic-actuated signal, 50 or more left turning vehicles per hour in one direction with the product of the turning and conflicting through traffic during the peak hour of 100,000 or more.***

This particular intersection is a semi-actuated traffic signal since it has vehicle detection loops on each approach. Therefore, (50) or more left-turning vehicles per hour in one direction are required, along with the left/conflicting-through vehicle product of 100,000. The ITE guidelines similarly have minimum cross-products of 100,000 and 144,000 when opposed by 3 or 2 lanes, respectively.

It is noted, the conflicting-through, or opposing, traffic volumes used in this analysis do include the right-turning traffic. This is due to left-turning drivers on Los Alamitos Boulevard most likely yielding to right-turners as well as through-traffic since it will require merging/sharing the Bradbury Road lane.

Intersection peak-hour turning movement counts were gathered at the intersection of Los Alamitos Boulevard and Bradbury Road to determine the activity level during a typical mid-week time period. The traffic volumes were collected on Tuesday, September 18, 2012. The morning peak-hour was determined to start at 7:15 AM and the afternoon peak-hour at 4:45 PM.

Peak-hour traffic volume data is included in Appendix C.

Table 2 on the next page summarizes the weekday peak-hour traffic counts.

Traffic Volumes (continued)

TABLE 2
INTERSECTION WEEKDAY
PEAK-HOUR VEHICLE TURNING MOVEMENT COUNTS

Intersection	Peak Hour	Northbound			Southbound			Eastbound			Westbound		
		L	T	R	**L**	T	R	**L**	T	R	**L**	T	R
Los Alamitos Boulevard and Bradbury Road	AM	**111**	1233	15	**14**	1114	176	**291**	17	107	**63**	13	32
	PM	**100**	1296	48	**16**	1536	195	**154**	9	79	**47**	5	15

L = Left-turning vehicles
T = Through vehicles
R = Right-turning vehicles

As highlighted in Table 2 above, the northbound left-turn movements meet the minimum (50) left-turning vehicles per hour in one direction that is needed to partially satisfy the California MUTCD Traffic Volume guideline described above.

The remaining portion of the guideline specifies that the product of the left-turning movement and the conflicting-through traffic during the peak-hour equal 100,000 or greater. As shown in Table 3 below, this portion of the guideline is satisfied for the northbound left-turn approach to the intersection during both peak periods. Therefore, the volumes do meet the minimum product of 100,000 per CA MUTCD and ITE guidelines.

TABLE 3
LEFT-TURN PHASING CROSS-PRODUCT CHECK
LOS ALAMITOS BOULEVARD AT BRADBURY ROAD

Product of Left-Turns and Opposing Through Movements	Peak Hour	Northbound			Southbound			Eastbound			Westbound		
		Left	Opposing Thru	**Product**	Left	Opposing Thru	**Product**	Left	Opposing Thru	**Product**	Left	Opposing Thru	**Product**
	AM	111	1290	**143,190**	14	1248	**17,472**	291	45	13,095	63	124	7,812
	PM	100	1731	**173,100**	16	1344	**21,504**	154	20	3,080	47	88	4,136

Traffic Volumes (continued)

In comparison to the California MUTCD, the guidelines given in the Highway Capacity Manual (HCM), 2010 edition, have minimum cross-products that are associated with the number of opposing through-lanes. The threshold set by the HCM establishes a minimum cross-product of 50,000 for left-turns opposed by one (1) through-lane, 90,000 when opposed by (2) lanes, and 110,000 with (3) opposing lanes. Similarly, it is shown from the table above that the northbound left-turn approach does meet the minimum product of 110,000 in both peak periods. It is common engineering practice to install left-turn phasing in both opposing directions, even if only one direction meets the guidelines, to provide consistency for drivers' expectations. Consequently, the traffic volumes do support the existing installation of fully-protected left-turn phasing on Los Alamitos Boulevard.

Miscellaneous

Speeds

As mentioned, north of Bradbury Road, Los Alamitos Boulevard has a posted speed limit of 40 MPH and an 85th percentile (critical) speed of 42.6 MPH ***(see Appendix D)***. South of Bradbury Road, the posted speed limit is 45 MPH. These speeds correspond with speeds that may be expected on an urbanized three-lane arterial roadway. Although posted 40 MPH, it is not uncommon to find drivers travelling approximately 5 MPH over the speed limit. Consequently, 45 and 50 MPH speeds were also considered.

Sight Distance

The geometry of the intersection is relatively flat and does not have horizontal and vertical roadway curvature to account for. It was found that the geometry presents a roadway intersection that does not need special traffic signal head locations for impaired visibility or advanced signage for overall improved sight distance.

Miscellaneous (continued)

Sight Distance (cont'd)

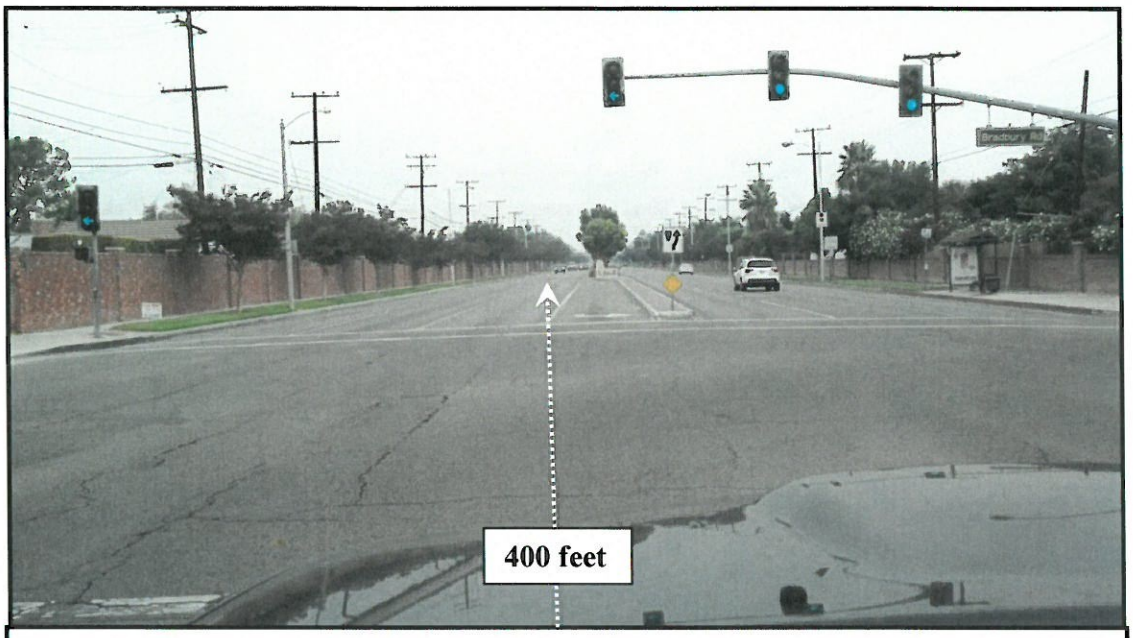
As Los Alamitos Boulevard is a truck route, buses and trucks were observed on Los Alamitos Boulevard. Large trucks were observed making left-turns at this residential/commercial intersection, especially in regards to accessing the gas station at the southwest corner.

Sight distance for the left-turning drivers was especially considered during our field-review of the surrounding urbanized residential/commercial environment. More specifically, a left-turning driver's sight distance, or visibility, was measured from a typical stopped-vehicle location in the northbound and southbound left-turn lanes. The measured distances were applied to the Stopping Sight Distance as a Function of Speed Guidelines found in the California MUTCD ***(see Appendix E)***. In these guidelines, roadway speeds of 40, 45, and 50 MPH recommend a minimum Stopping Sight Distance of 305, 360, and 425 feet, respectively. The HCM does not include guidelines on sight distance. The ITE guidelines state that restrictive sight distance is when there is less than 400 feet for roadway speeds of 40 MPH or more. As a result, 400 feet was used for sight distance when looking in the northbound direction, and 425 feet for southbound.

These stopping sight distances were field-measured from a typical 'stopped' left-turning vehicle location looking towards the nearest lane of on-coming traffic. An orange cone was set on the lane line at this distance. As shown in Exhibits 3 and 4 on the next pages, a photograph was then taken from a left-turning driver's perspective in order to determine if a clear line of sight to the cone was met.

As can be seen, the field measurement for actual 'clear' sight distance for a northbound and southbound left-turning vehicle resulted in at least 400 and 425 feet, respectively. Therefore, sight distance is not considered restrictive; however, 45 and especially 50 MPH speeds are considered 'higher' roadway speeds.

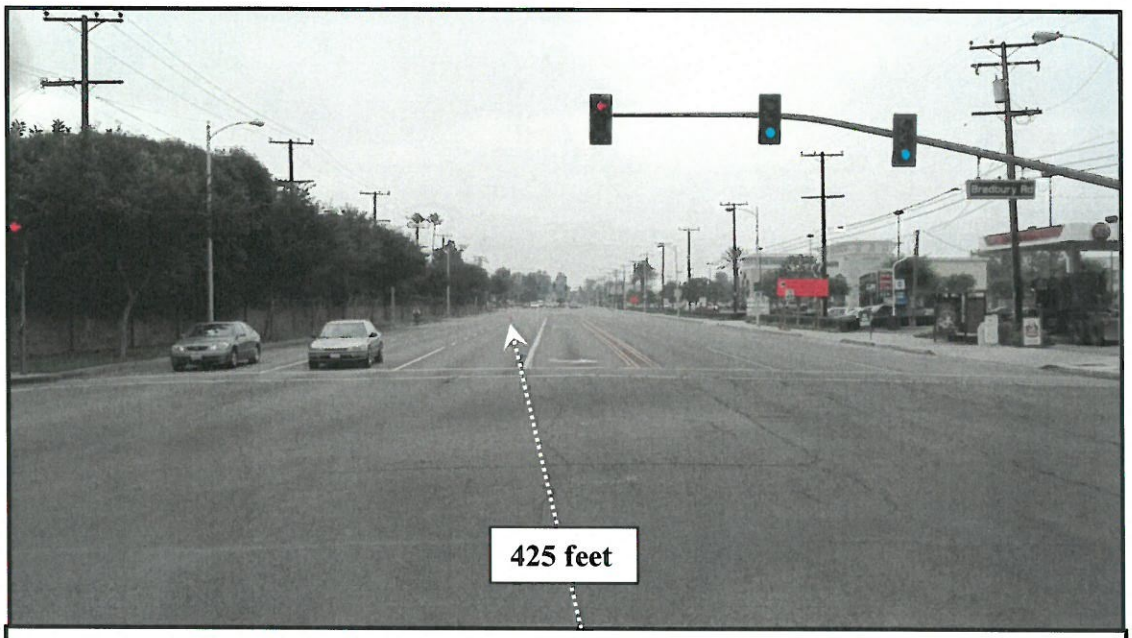
EXHIBIT 3



NB Seal Beach Boulevard Looking at Oncoming SB Traffic

Aerial Image of NB Seal Beach Boulevard Looking at Oncoming SB Traffic

EXHIBIT 4



SB Los Alamitos Boulevard Looking at Oncoming NB Traffic

Aerial Image of SB Los Alamitos Boulevard Looking at Oncoming NB Traffic

ANALYSIS SUMMARY

Based on collisions reported for the intersection during the past 10 years, none were found to involve north and south left-turning movements. Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected that left-turn accidents may occur with protected-permissive left-turn phasing.

Based on the minimum traffic volume guidelines set forth in three references, this analysis showed that existing traffic volumes at this intersection (amount of left-turns and opposing through-movements) did satisfy the minimum volume guidelines for supporting the existing installation of protected left-turn phasing.

Engineering judgment should always be included in any decision regarding traffic improvements; as a result, the geometry of the intersection was noted as not having any horizontal and vertical curvature to consider. Upon field verification, it was found that this geometry presents a roadway intersection that does not need special traffic signal head locations or advanced signage for impaired sight distance or improving overall visibility.

Moreover, a driver's visibility was also checked from a typical stopped left-turning vehicle location on both northbound and southbound approaches. A 400-foot and 425-foot stopping sight distance was field-measured from these locations looking towards the nearest lane of on-coming traffic, and an orange cone was set on the lane line. A photograph was then taken from a driver's perspective in order to determine if a clear line of sight to the cone was met. The actual sight distance for a northbound and southbound left-turning vehicle resulted in at least 400 feet and 425 feet, respectively. Therefore, sight distance is not considered restrictive; however, it should be mentioned that 45 and 50 MPH speeds used in this analysis are considered 'higher' roadway speeds.

RECOMMENDATION

Based on the findings of this analysis, the installation of protected-permissive left-turn phasing is not recommended for the intersection of Los Alamitos Boulevard and Bradbury Road due to the following reasons:

- There are sufficient traffic volumes that satisfy all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.
- There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers need to account for.
- The northbound approach (south leg of the intersection) has a posted speed limit of 45 MPH, which is considered 'higher' roadway speeds.
- Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, it can be expected that left-turn type accidents may occur if modified to protected-permissive.

APPENDIX A

LEFT-TURN PHASING GUIDELINES:

CALIFORNIA MUTCD,
HIGHWAY CAPACITY MANUAL,
and
ITE TRAFFIC ENGINEERING HANDBOOK

CALIFORNIA MUTCD

CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.

E. A supplementary sign shall not be required. ~~If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

06 The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

Section 4D.19 Signal Indications for Protected Only Mode Left-Turn Movements

Standard:

01 **A shared signal face shall not be used for protected only mode left turns unless the CIRCULAR GREEN and left-turn GREEN ARROW signal indications always begin and terminate together. If a shared signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-9):**

A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR GREEN, and left-turn GREEN ARROW. Only one of the three colors shall be displayed at any given time.

B. During the protected left-turn movement, the shared signal face shall simultaneously display both a CIRCULAR GREEN signal indication and a left-turn GREEN ARROW signal indication.

C. The shared signal face shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20).

Option:

02 A straight-through GREEN ARROW signal indication may be used instead of the CIRCULAR GREEN signal indication in Items A and B in Paragraph 1 on an approach where right turns are prohibited and a straight-through GREEN ARROW signal indication is also used instead of a CIRCULAR GREEN signal indication in the other signal face(s) for through traffic.

Standard:

03 **If a separate left-turn signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-10):**

A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a LEFT ON GREEN ARROW ONLY (R10-5) sign (see Figure 2B-27).

B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face that is used for the protected/permissive mode (see Section 4D.20 and Figures 4D-8 and 4D-12) except that the flashing left-turn YELLOW ARROW or flashing left-turn RED ARROW signal indication shall not be displayed when operating in the protected only mode.

Guidance:

04 *Since separate signal phases for protected left turns will reduce the green time available for other phases, alternate means of handling left turn conflicts should be considered first.*

Support:

05 The most likely possibilities are:

1. Prohibition of left turns. This can be done only if there are convenient alternate means of making the movement. Typical alternate means are:
   a. A series of right and/or left turns around a block to permit getting to the desired destination; or
   b. Making the left turn at an adjacent unsignalized intersection during gaps in the opposing through traffic.
2. Geometric changes to eliminate the left turn. An effective change would be a complete separation or a complete or partial "clover leaf" at grade. Any of these, while eliminating left turns, requires additional cost and right of way.
3. Provide protected-permissive or permissive-protected left turn operation. The protected left turn interval may be prohibited during certain periods of the day to allow only permissive intervals for left turn movement in order to increase the green time available for other phases. Refer to Section 4D.20 for the requirements of protected-permissive or permissive-protected left turn operation.

Guidance:

06 *Protected left turn phases should be considered where such alternatives couldn't be utilized, and one or more of the following conditions exist:*

1. *Collisions - Five or more left turn collisions for a particular left turn movement during a recent 12-month period.*
2. *Delay - Left-turn delay of one or more vehicles, which were waiting at the beginning of the green interval and are still remaining in the left turn lane after at least 80% of the total number of cycles for one hour.*
3. *Volume - At new intersections where only estimated volumes are available, the following criteria may be used. For pretimed signal or a background-cycle-controlled actuated signal, a left turn volume of more than two vehicles per approach per cycle for a peak hour; or for a traffic-actuated signal, 50 or more left turning vehicles per hour in one direction with the product of the turning and conflicting through traffic during the peak hour of 100,000 or more.*
4. *Miscellaneous. Other factors that might be considered include but are not limited to: impaired sight distance due to horizontal or vertical curvature, or where there are a large percentage of buses and trucks.*

Section 4D.20 Signal Indications for Protected/Permissive Mode Left-Turn Movements

Standard:

01 If a shared signal face is provided for a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-11):

A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR green, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three circular indications shall be displayed at any given time. Only one of the two arrow indications shall be displayed at any given time. If the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are always terminated together, the steady left-turn YELLOW ARROW signal indication shall not be required.

B. During the protected left-turn movement, the shared signal face shall simultaneously display a left-turn GREEN ARROW signal indication and a circular signal indication that is the same color as the signal indication for the adjacent through lane on the same approach as the protected left turn.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication, unless the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are being terminated together. When the left-turn GREEN ARROW and CIRCULAR GREEN signal indications are being terminated together, the required display following the left-turn GREEN ARROW signal indication shall be either the display of a CIRCULAR YELLOW signal indication alone or the simultaneous display of the CIRCULAR YELLOW and left-turn YELLOW ARROW signal indications.

D. During the permissive left-turn movement, the shared signal face shall display only a CIRCULAR GREEN signal indication.

E. A protected/permissive shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

F. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign (see Figure 2B-27).

02 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.**

03 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-12):**

A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.

B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

D. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.

E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.

F. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.

G. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn YELLOW ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn YELLOW ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.

H. The display shall be a four-section signal face except that a three-section signal face containing a dual-arrow signal section shall be permitted where signal head height limitations (or lateral positioning limitations for a horizontally-mounted signal face) will not permit the use of a foursection signal face. The dual-arrow signal section, where used, shall display a GREEN ARROW for the protected left-turn movement and a flashing YELLOW ARROW for the permissive left-turn movement.

I. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.

J. During flashing mode operation (see Section 4D.30), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.

Option:

04 A separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.

Standard:

05 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-8):**

A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.

B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.

C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.

D. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed.

E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.

F. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn RED ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn RED ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.

G. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.

H. A supplementary sign shall not be required. ~~If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

06 The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

Standard:

07 **Protected/permissive mode left-turn shall not be used for left turn movements that oppose phases that require preemption for rail traffic.**

Section 4D.21 Signal Indications for Right-Turn Movements – General

Standard:

01 **In Sections 4D.21 through 4D.24, provisions applicable to right-turn movements and right-turn lanes shall also apply to signal indications for U-turns to the right that are provided at locations where right turns are prohibited or not geometrically possible.**

Support:

02 Right-turning traffic is controlled by one of four modes as follows:

A. Permissive Only Mode—turns made on a CIRCULAR GREEN signal indication, a flashing right-turn YELLOW ARROW signal indication, or a flashing right-turn RED ARROW signal indication after yielding to pedestrians, if any.

B. Protected Only Mode—turns made only when a right-turn GREEN ARROW signal indication is displayed.

C. Protected/Permissive Mode—both modes occur on an approach during the same cycle.

D. Variable Right-Turn Mode—the operating mode changes among the protected only mode and/or the protected/permissive mode and/or the permissive only mode during different periods of the day or as traffic conditions change.

Standard:

03 **During a permissive right-turn movement, the signal faces, if any, that exclusively control U-turn traffic that conflicts with the permissive right-turn movement (see Item F.1 in Section 4D.05) shall simultaneously display steady U-turn RED ARROW signal indications. If pedestrians crossing the lane or lanes used by the permissive right-turn movement to depart the intersection are controlled by pedestrian signal heads, the signal indications displayed by those pedestrian signal heads shall not be limited to any particular display during the permissive right-turn movement.**

04 **During a protected right-turn movement, the signal faces for left-turn traffic, if any, on the opposing approach shall not simultaneously display a steady left-turn GREEN ARROW or steady left-turn**

HIGHWAY CAPACITY MANUAL

Exhibit 31-38
Quick Estimation Left-Turn Treatment Worksheet

QUICK ESTIMATION LEFT-TURN TREATMENT WORKSHEET

General Information

Description Intersection of Los Alamitos Blvd at Bradbury Rd.

Check # 1. Left-Turn Lane Check

Approach	EB	WB	NB	SB
Number of left-turn lanes	Ø	Ø	1	1
Protect left turn (Y or N)?	N	N	N	N

If the number of left-turn lanes on any approach exceeds 1, then it is recommended that the left turns on that approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.

Check # 2. Minimum Volume Check

Approach	EB	WB	NB	SB
Left-turn volume	291	63	111	16
Protect left turn (Y or N)?	Y	N	N	N

If left-turn volume on any approach exceeds 240 veh/h, then it is recommended that the left turns on that approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.

Check # 3. Minimum Cross-Product Check

Approach	EB	WB	NB	SB
Left-turn volume, V_L (veh/h)	291	63	111	16
Opposing mainline volume, V_o (veh/h)	45	124	1,290	1,344
Cross-product ($V_L * V_o$)	13,095	7,812	143,190	21,504
Opposing through lanes	1	1	3	3
Protected left turn (Y or N)?	N	N	Y	N

Minimum Cross-Product Values for Recommending Left-Turn Protection

Number of Through Lanes	Minimum Cross-Product
1	50,000
2	90,000
3	110,000

If the cross-product on any approach exceeds the above values, then it is recommended that the left turns on that approach be protected. Those approaches with protected left turns need not be evaluated in subsequent checks.

Check # 4. Sneaker Check

Approach	EB	WB	NB	SB
Left-turn volume, V_L (veh/h)	291	63	111	16
Sneaker capacity, c_s (veh/h) $c_s = 7200/C$	60	60	60	60
Equivalence factor, E_{L1}	1.3	1.4	>4.0	>4.0
Protected left turn (Y or N)?	N	N	Y	N

If the equivalence factor is 3.5 or higher (computed in the Quick Estimation Lane Volume Worksheet) and the unadjusted left turn is greater than the sneaker capacity, then it is recommended that the left turns on that approach be protected.

Notes

1. If any approach is recommended for left-turn protection but the analyst evaluates it as having permitted operation, then this quick estimation method may give overly optimistic results. The analyst should instead use the methodology described in Chapter 18, Signalized Intersections.
2. All volumes used in this worksheet are unadjusted hourly volumes.

Step 2: Determine Lane Volume

The lane volume worksheet is shown in Exhibit 31-39. Its purpose is to establish the individual lane flow rate (in veh/h/ln) on each intersection approach. This information is then used in the control delay and level-of-service worksheet to synthesize the signal-timing plan. The directional designations (e.g., RT = right turn, LT = left turn) refer to the traffic movements as they approach the intersection.

The number of through lanes N_{TH} includes any lane that serves through vehicles. Exclusive turn lanes should be excluded.

For an unopposed shared lane, the total approach volume V_{tot} is the sum of the shared-lane right-turn volume, through volume, and left-turn volume.

D. Compute Lane Volume for Through Movement with Exclusive Turn Lane

For approaches with an exclusive left-turn lane (or lanes), the through-lane volume V_{TH} is computed by dividing total approach volume by the number of through lanes.

The critical lane volume V_{CL} is normally the same as the through-lane volume, unless the right turn has an exclusive lane or the left turn is not opposed and either of these movements is more critical than the through movement. If both conditions apply, the critical lane volume will be the largest of the left-lane volume, exclusive right-lane volume, and through-lane volume.

E. Compute Lane Volume for Through Movement with Shared Lane

The computation of critical lane volume in the case of shared left-turn lanes is more complicated and requires a more detailed computational procedure. The equivalence factor E_{L1} for a permitted left turn is obtained from Exhibit 31-40 or computed with Equation 31-152.

Exhibit 31-40
Through-Car Equivalents for Permitted Left Turns

Type of Left-Turn Lane	Through-Car Equivalent E_{L1} as a Function of Opposing Flow Rate (veh/h)						
	1	200	400	600	800	1,000	1,200[a]
Shared	1.4	1.7	2.1	2.5	3.1	3.7	4.5
Exclusive	1.3	1.6	1.9	2.3	2.8	3.3	4.0

Note: [a] Use Equation 31-152, with Equation 31-153, for opposing flow in excess of 1,200 veh/h; v_o must be ≥ 0.1 veh/h.

Equation 31-152

$$E_{L1} = \frac{s_o}{s_p} - I_{sh}$$

with

Equation 31-153

$$s_p = \frac{v_o \, e^{-v_o \, t_{cg} / 3{,}600}}{1 - e^{-v_o \, t_{fl} / 3{,}600}}$$

where

E_{L1} = equivalent number of through cars for a permitted left-turning vehicle,

s_o = base saturation flow rate (pc/h/ln),

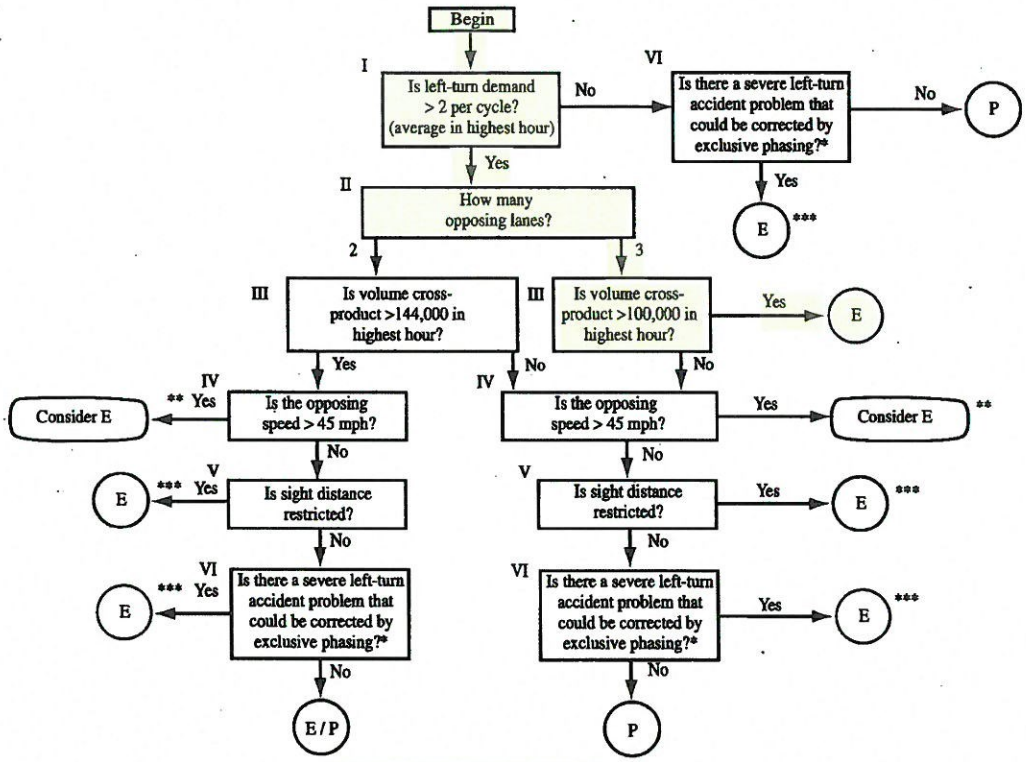
s_p = saturation flow rate of a permitted left-turn movement (veh/h/ln),

I_{sh} = indicator variable for shared lane (= 1.0 if the subject left turn is served in a shared lane, 0 if the subject left turn is served in an exclusive lane),

v_o = opposing demand flow rate (veh/h),

t_{cg} = critical headway = 4.5 (s), and

ITE TRAFFIC ENGINEERING HANDBOOK



P – Permissive

E/P – Exclusive/Permissive

E – Exclusive

Note: This procedure applies to locations with a separate left-turn lane.

Restrictive Sight Distance is:

< 250 ft when speeds are 35 mph or less;

< 400 ft when speeds are 40 mph or more.

* See text for definition of severe left-turn accident problem.

** An opposing speed > 45 mph indicates a potential left-turn accident problem. Consider exclusive phasing, realizing that non-left-turn accidents may increase.

*** Use exclusive phasing with the understanding that non-left-turn accidents may increase.

Figure 13–7 Recommended Procedure for Determining Type of Left-Turn Phasing

Source: J.E. Upchurch, "Guidelines for Selecting Type of Left-Turn Phasing," *Traffic Control Devices and Rail-Highway Crossings,* Transportation Research Record 1069, Washington, D.C.: Transportation Research Board, National Research Council, 1986, p. 30.

The University of Texas at Arlington has developed guidelines for left-turn phasing based on research, actual field data, easy-to-use quantitative measures, and statistical analysis of most suitable left-turn options. The process favors the least restrictive option—permitted left-turn—unless traffic and geometrics warrant a more restrictive control.[16] The decisions to be made are classified into three levels summarized as follows and shown in Figure 13–8.

Level 1: Permissive-Only Versus Some Protection

The permissive option should be used only if all of the following conditions exist:

[16] S.A. Asante, S.A. Ardekani, and J.C. Williams, "Selection Criteria for Left-Turn Phasing and Indication Sequence," *Traffic Control Devices, Visibility, and Traffic Signal Systems,* Transportation Research Record 1421 (Washington, D.C.: Transportation Research Board, National Research Council, 1993), p. 11.

APPENDIX B

INTERSECTION COLLISION HISTORY DATA

CITY OF LOS ALAMITOS
SWITRS COLLISION HISTORY 2001 TO 2011
INTERSECTION OF LOS ALAMITOS BLVD AND BRADBURY RD

CASE ID	COLLISION DATE	COLL. TIME	PRIMARY ROAD	SECONDARY ROAD	DISTANCE	DIRECTION	INTERSECTION	WEATHER 1	COLLISION SEVERITY	PRIMARY COLL FACTOR	PCF VIOL CAT.	HIT AND RUN	TYPE OF COLL.	MOTOR VEHICLE INVOLVED WITH	ROAD SURF.
3013010403073400000	20010403	734	LOS ALAMITOS BL	BRADBURY	0	-	Y	B	0	A	8	N	B	C	A
100901	20020312	2024	LOS ALAMITOS BL	BRADBURY RD	0		N	A	4	A	21	N	C	C	A
181267	20020422	1403	LOS ALAMITOS BL	BRADBURY ST	66	N	-	A	0	A	3	N	C	C	A
811352	20030513	1520	LOS ALAMITOS BL	BRADBURY RD	0		Y	A	0	A	3	M	C	C	A
1555499	20040728	1850	LOS ALAMITOS BL	BRADBURY	91	N	N	A	0	A	3	N	C	C	A
1977476	20050415	2027	BRADBURY ST	LOS ALAMITOS BL	0		Y	A	0	A	9	N	A	C	A
4008117	20081224	1419	LOS ALAMITOS BL	BRADBURY RD	174	N	N	B	3	A	8	F	C	C	A
4159599	20090310	200	LOS ALAMITOS BL	BRADBURY RD	23	N	N	A	0	A	1	N	E	I	A
5051342	20101223	1443	LOS ALAMITOS BL	BRADBURY RD	0		Y	A	0	A	8	N	B	I	A

NOTES:

Weather 1
A - Clear
B - Cloudy
C - Raining
D - Snowing
E - Fog
F - Other
G - Wind
- - Not Stated

Collision Severity
1 - Fatal
2 - Injury (Severe)
3 - Injury (Other Visible)
4 - Injury (Complaint of Pain)
0 - PDO (Property Damage Or

Primary Collision Factor
A - (Vehicle) Code Violation
B - Other Improper Driving
C - Other Than Driver
D - Unknown
E - Fell Asleep
- - Not Stated

PCF Violation Category
01 - Driving or Bicycling Under Influence
02 - Impeding Traffic
03 - Unsafe Speed
04 - Following Too Closely
05 - Wrong Side of Road
06 - Improper Passing
07 - Unsafe Lane Change
08 - Improper Turning
09 - Automobile ROW
10 - Pedestrian ROW
11 - Pedestrian Violation
12 - Traffic Signals and Signs
13 - Hazardous Parking
14 - Lights
15 - Brakes
16 - Other Equipment
17 - Other Hazardous Violation
18 - Other Than Driver (or Ped)
19 -
20 -
21 - Unsafe Starting or Backing
22 - Other Improper Driving
23 - Pedestrian or "Other" Under the Influence
24 - Fell Asleep
00 - Unknown
- - Not Stated

Hit and Run
F - Felony
M - Misdemeanor
N - Not Hit & Run

Type of Collision
A - Head-On
B - Sideswipe
C - Rear-End
D - Broadside
E - Hit Object
F - Overturned
G - Vehicle/Pedestrian
H - Other
- - Not Stated

Motor Vehicle Involved With:
A - Non-Collision
B - Pedestrian
C - Other Motor Vehicle
D - Motor Vehicle on Other Roadway
E - Parked Motor Vehicle
F - Train
G - Bicycle
H - Animal
I - Fixed Object
J - Other Object
- - Not Stated

Road Surface
A - Dry
B - Wet
C - Snowy or Icy
D - Slippery
- - Not Stated

APPENDIX C

PEAK-HOUR TURNING MOVEMENT

TRAFFIC VOLUME DATA

ITM Peak Hour Summary

Prepared by:

NDS

National Data & Surveying Services

Los Alamitos Blvd and Bradbury Rd , City of Los Alamitos

Date: 9/18/2012

Day: Tuesday

Project #: CA12_1195_002

AM Peak Hour	715 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (Los Alamitos Blvd)

	Lanes 0	3	1		
AM	176	1114	14	1556	AM
NOON	0	0	0	0	NOON
PM	195	1536	16	1465	PM

Eastbound Approach (Bradbury Rd)

Lanes	AM	NOON	PM
	300	0	300
0	291	0	154
1	17	0	9
0	107	0	79

Westbound Approach

Lanes	AM	NOON	PM
1	32	0	15
1	13	0	5
0	63	0	47
	46	0	73

Northbound Approach

AM	1284	111	1233	15	AM
NOON	0	0	0	0	NOON
PM	1662	100	1296	48	PM
		1	3	0	Lanes

CONTROL: Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	6:00 PM

Total Ins & Outs

	North Leg		
AM	1304	1556	AM
NOON	0	0	NOON
PM	1747	1465	PM

West Leg	AM	NOON	PM
	300	0	300
	415	0	242

East Leg	AM	NOON	PM
	108	0	67
	46	0	73

South Leg		
AM	1284	1359
NOON	0	0
PM	1662	1444

Total Volume Per Leg

North Leg		
AM	2860	
NOON	0	
PM	3212	

West Leg	AM	NOON	PM
	715	0	542

East Leg	AM	NOON	PM
	154	0	140

South Leg	
AM	2643
NOON	0
PM	3106

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: CA12_1195_002

Day: TUESDAY

City: City of Los Alamitos

Date: 9/18/2012

AM

NS/EW Streets:	Los Alamitos Blvd			Los Alamitos Blvd			Bradbury Rd			Bradbury Rd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	1	3	0	0	1	0	0	1	1	
7:00 AM	8	245	5	1	175	14	66	1	28	10	1	5	559
7:15 AM	16	348	1	4	228	23	77	3	14	18	0	12	744
7:30 AM	47	330	2	4	252	63	53	3	24	21	4	6	809
7:45 AM	33	291	4	5	338	68	74	7	38	14	9	7	888
8:00 AM	15	264	8	1	296	22	87	4	31	10	0	7	745
8:15 AM	17	288	1	5	200	33	68	1	22	11	0	8	654
8:30 AM	10	273	6	4	222	23	47	1	13	6	0	4	609
8:45 AM	14	234	2	2	212	25	33	2	14	16	0	4	558
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	160	2273	29	26	1923	271	505	22	184	106	14	53	5566
APPROACH %'s :	6.50%	92.32%	1.18%	1.17%	86.62%	12.21%	71.03%	3.09%	25.88%	61.27%	8.09%	30.64%	
PEAK HR START TIME :	715 AM												TOTAL
PEAK HR VOL :	111	1233	15	14	1114	176	291	17	107	63	13	32	3186
PEAK HR FACTOR :		0.896			0.793			0.850			0.871		0.897

CONTROL : Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

Project ID: CA12_1195_002 **Day:** TUESDAY

City: City of Los Alamitos **Date:** 9/18/2012

PM

NS/EW Streets:	Los Alamitos Blvd			Los Alamitos Blvd			Bradbury Rd			Bradbury Rd			
	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	1	3	0	0	1	0	0	1	1	
4:00 PM	21	291	12	6	286	40	36	3	15	9	4	4	727
4:15 PM	28	309	11	1	275	43	27	1	12	13	0	3	723
4:30 PM	25	322	16	2	384	36	32	2	17	10	0	4	850
4:45 PM	20	314	12	5	383	44	56	4	29	15	2	6	890
5:00 PM	21	332	15	4	366	62	29	1	15	13	2	2	862
5:15 PM	28	320	7	2	412	45	31	3	24	10	0	3	885
5:30 PM	31	330	14	5	375	44	38	1	11	9	1	4	863
5:45 PM	21	337	12	4	332	40	41	1	12	15	2	2	819
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
TOTAL VOLUMES :	195	2555	99	29	2813	354	290	16	135	94	11	28	6619
APPROACH %'s :	6.84%	89.68%	3.47%	0.91%	88.02%	11.08%	65.76%	3.63%	30.61%	70.68%	8.27%	21.05%	
PEAK HR START TIME :	445 PM												TOTAL
PEAK HR VOL :	100	1296	48	16	1536	195	154	9	79	47	5	15	3500
PEAK HR FACTOR :		0.963			0.952			0.680			0.728		0.983

CONTROL : Signalized

APPENDIX D

ENGINEERING AND TRAFFIC SURVEY

FOR

LOS ALAMITOS BOULEVARD

CITY OF LOS ALAMITOS

ENGINEERING AND TRAFFIC SURVEY
FIELD REVIEW FORM

LOS ALAMITOS BOULEVARD — **FARQUHAR AVENUE TO BRADBURY ROAD**

FIELD REVIEW BY: C. BUENDIA — CHECKED BY: JERRY STOCK — DATE: 5/12/03

FACTORS	DIRECTION: NORTHBOUND	DIRECTION: SOUTHBOUND
A. PREVAILING SPEED DATA		
DATE OF SURVEY	05/12/03	05/12/03
LOCATION OF SURVEY	NORTH OF BRADBURY	NORTH OF BRADBURY
85TH PERCENTILE	42.6 MPH	42.6 MPH
10 MPH PACE	35 - 44 MPH	34 - 43 MPH
PERCENT IN PACE	66.9 %	71.8 %
POSTED SPEED LIMIT	40 MPH / 25 MPH**	40 MPH / 25 MPH**
B. ACCIDENT HISTORY		
NO. OF MONTHS COVERED	36	36
SPEED-RELATED ACCIDENTS	1	0
TOTAL ACCIDENTS	5	0
ANNUAL ACCIDENT RATE	0.33 ACCIDENTS PER YEAR (SPEED ONLY)	0.00 ACCIDENTS PER YEAR (SPEED ONLY)
ACCIDENTS/MIL. VEH. MILES	0.05 ACCIDENTS PER MVM (SPEED ONLY)	0.00 ACCIDENTS PER MVM (SPEED ONLY)
C. TRAFFIC FACTORS		
AVERAGE DAILY TRAFFIC	21,150	21,150
LANE CONFIGURATION	3 LANES	3 LANES
TRAFFIC CONTROLS	SIGNAL - FARQUHAR / ORANGEWOOD & >	AND SIGNAL - ROSSMOOR / BRADBURY
CROSSWALKS	AT SIGNALS	AT SIGNALS
PEDESTRIAN/BICYCLES	YES / YES	YES / YES
TRUCK TRAFFIC	YES	YES
ON-STREET PARKING	NO PARKING ANYTIME	NO PARKING ANYTIME
OTHER (SPECIFY)		
D. ROADWAY FACTORS		
LENGTH OF SEGMENT (MILES)	0.81	0.81
VERTICAL CURVE	NONE	NONE
HORIZONTAL CURVE	NONE	NONE
LATERAL VISIBILITY	GOOD	GOOD
SURFACE CONDITION	GOOD	GOOD
SIDEWALKS/DRIVEWAYS	YES / YES	YES / NO
STREET LIGHTING	YES	YES
DRIVEWAY DENSITY	LIGHT	NONE
OTHER (SPECIFY)		
E. ADJACENT LAND USES	COMMERCIAL / BUSINESS / RES / CHURCH	RESIDENTIAL
RECOMMENDED SPEED LIMIT	40 MPH	40 MPH
SPEED LIMIT CHANGE?	NO	NO

** 25 MPH WHEN CHILDREN PRESENT, SCHOOL ZONE

APPENDIX E

STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED

CALIFORNIA MUTCD

Table 6C-1. Recommended Advance Warning Sign ~~Minimum~~ Spacing

Road Type	Distance Between Signs*		
	A	B	C
Urban (low speed) - 25 mph or less	100 feet	100 feet	100 feet
Urban (high speed) - more than 25 mph to 40 mph	250 feet	250 feet	250 feet
Urban (high speed) - more than 40 mph	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

* ~~Speed category to be determined by the highway agency.~~
** The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

Table 6C-2. Stopping Sight Distance as a Function of Speed

Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed.
Can also be used as Stopping Sight Distance as suggested buffer space length or location for flagger station.

Table 6C-3. Taper Length Criteria for Temporary Traffic Control Zones

Type of Taper	Taper Length
Merging Taper	at least L
Shifting Taper	at least 0.5 L
Shoulder Taper	at least 0.33 L
One-Lane, Two-Way Traffic Taper	50 feet minimum, 100 feet maximum
Downstream Taper	50 feet minimum, 100 feet maximum

Note: Use Table 6C-4 to calculate L

City of Los Alamitos

Agenda Report	December 12, 2012
Discussion Item	Item No: 7C

To: Chairman and Members of the Traffic Commission

From: David Hunt, PE, City Engineer

Subject: Consideration of a Signal Modification at Los Alamitos Boulevard at Rossmoor Way and Bradbury Road

Summary: A request has been received to look at changing the left-turn signal phases at Los Alamitos Boulevard @ Rossmoor Way and Bradbury Road going into the Highlands Neighborhood.

Recommendation: Based on the findings of staff's analysis, the installation of protected-permissive left-turn phasing is not recommended.

Background

Hartzog & Crabill, Inc. (HCI) has completed a 'Left-Turn Phasing Warrant Analysis' for the subject intersections. The analysis was completed in response to the City's request to verify if protected-permissive left-turn phasing is warranted and recommended, based on meeting standard guidelines.

Discussion

At the present time, the intersection is signalized with a 5-phase operation with protected left-turn phasing on Los Alamitos Boulevard The California Manual of Uniform Traffic Control Devices (*California MUTCD*) was used for defining the requirements for left-turn phasing, as well as the Highway Capacity Manual (*HCM*) and Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. Based on these guidelines, there are four conditions considered for left-turn phasing:

1) Accident History;

2) Delay;

3) Traffic Volumes; and

4) Miscellaneous (*i.e., impaired sight distance, roadway curvature, etc.*).

Based on the findings of our analysis, the installation of protected-permissive left-turn phasing is not recommended due to the following reasons:

- There were sufficient traffic volumes that met all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.

- Sight distance is considered restrictive for the northbound left-turning driver, as the actual sight distance measured to the nearest oncoming lane of traffic is less than 400 feet when a vehicle was in the opposing left-turn lane.

- There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers would need to account for under the 'permissive' portion.

- Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, and one left-turn collision still occurred within the last 10 years, it can be expected that an increase in left-turn type accidents will occur if modified to protected-permissive.

Hartzog & Crabill, Inc. did some adjustments to both signals December 5, 2012, to improve the left-turn movement into the Highlands neighborhood. The midday coordination plan, which operated Monday - Friday between 1:00 pm and 3:35 pm, has been disabled. During this period, and all other non-coordinated times (7:00 pm to 7:00 am), these intersections will operate independently in "Free" mode. The free mode has also been modified to give preference to the vehicle(s) waiting in the southbound left-turn lanes. Due to the volumes on Los Alamitos Boulevard, the AM and PM coordination plans were not adjusted. These high traffic volume hours of operation are Monday - Friday, 7:00 to 9:00 am, and 3:35 to 7:00 pm.

Approved By:

David L. Hunt

David Hunt, PE
City Engineer

Attachments:
1. *Left-turn Phasing Analysis at the Intersection of Los Alamitos Blvd. and Rossmoor Way*
2. *Left-turn Phasing Analysis at the Intersection of Los Alamitos Blvd. and Bradbury Rd.*

ATTACHMENT 1

HARTZOG & CRABILL, Inc.

Trammell Hartzog, President
Jerry Crabill, P.E. (Retired)
Gerald J. Stock, P.E., Executive Vice-President

17772 E. 17th Street
Suite 101
Tustin, CA 92780

Phone: (714) 731-9455
FAX: (714) 731-9498

www.hartzog-crabill.com

November 7, 2012

Mr. Dave Hunt, P.E.
Director of Public Works/City Engineer
City of Los Alamitos
3191 Katella Avenue
Los Alamitos, CA 90720

Subject: Left-Turn Phasing Analysis at the Intersection of Los Alamitos Boulevard and Rossmoor Way

Dear Mr. Hunt:

Hartzog & Crabill, Inc. (HCI) has completed a Left-Turn Phasing Warrant Analysis for the subject intersection. As you will see in the attached report, the findings of this study show that the modification from protected to protected-permissive left-turn phasing on Los Alamitos Boulevard is not recommended for this intersection.

The analysis was completed in response to the City's request to verify if protected-permissive left-turn phasing is warranted, and recommended based on meeting standard guidelines. At the present time, the intersection is signalized with a 5-phase operation with protected left-turn phasing on Los Alamitos Boulevard. The California Manual of Uniform Traffic Control Devices (*California MUTCD*) was used for defining the requirements for left-turn phasing, as well as the Highway Capacity Manual (*HCM*) and Institute of Traffic Engineers (ITE) Traffic Engineering Handbook. Based on these guidelines, there are four conditions considered for left-turn phasing: 1) Accident History; 2) Delay; 3) Traffic Volumes; and 4) Miscellaneous (*i.e., impaired sight distance, roadway curvature, etc.*).

Based on the findings of our analysis, the installation of protected-permissive left-turn phasing is not recommended due to the following reasons:

- There were sufficient traffic volumes that met all three reference guidelines for supporting the current installation of fully-protected left-turn phasing.
- Sight distance is considered restrictive for the northbound left-turning driver, as the actual sight distance measured to the nearest oncoming lane of traffic is less than 400 feet when a vehicle was in the opposing left-turn lane.

- There are three opposing lanes with a significant amount of oncoming traffic that left-turning drivers would need to account for under the 'permissive' portion.
- Recognizing that this intersection already has fully-protected left-turn phasing on Los Alamitos Boulevard, and one left-turn collision still occurred within the last 10 years, it can be expected that an increase in left-turn type accidents will occur if modified to protected-permissive.

It has been our pleasure to prepare this analysis for the City of Los Alamitos. If you have any questions or need more information please call (714) 731-9455.

Regards,
HARTZOG & CRABILL, INC.

Mark J. Esposito, PE, TE, PTOE
Project Manager

Attach: Left-Turn Phasing Analysis Report

MINUTES OF TRAFFIC COMMISSION MEETING

CITY OF LOS ALAMITOS
3191 Katella Avenue
Los Alamitos, California

December 12, 2012

CALL TO ORDER

A regular meeting of the Traffic Commission was called to order at 7:03 p.m. on December 12, 2012, in the Council Chambers, 3191 Katella Avenue, Los Alamitos, Chair Norman Wray presiding.

ROLL CALL

PRESENT:	COMMISSIONERS	Emerson, Murphy, Schleuter, Vardeman, Wilhelm, Wray
ABSENT:	COMMISSIONER	
PRESENT:	STAFF	Dave Hunt, City Engineer Bruce McAlpine, Police Captain Sharon Nowell, Department Secretary

1. **CALL TO ORDER**
   Chair Wray called the meeting to order at 7:03 p.m.

2. **ROLL CALL**
   No Commissioners absent.

3. **PLEDGE OF ALLEGIANCE**
   The Pledge of Allegiance was led by Richard Murphy.

4. **ORAL COMMUNICATIONS**
   None

5. **ELECTION OF VICE CHAIR**
   Unanimously carried to appoint Johanna Schleuter as Vice Chair.

6. **MINUTES**
   Motion made to approve the minutes of the November 14, 2012 Regular Traffic Commission Meeting:

   Motion/Second: Murphy/Vardeman: Motion unanimously carried to approve the November 14, 2012 Traffic Commission meeting minutes. Vice Chair Schleuter abstained due to her absence at that meeting.

7. STAFF REPORTS

C. CONSIDERATION OF A SIGNAL MODIFICATION AT LOS ALAMITOS BOULEVARD AT ROSSMOOR WAY AND BRADBURY ROAD

City Engineer, Dave Hunt, gave a summary of the staff report and the information contained therein. He stated that conditions do not support protected-permissive left-turns at the intersections under discussion. However, Hartzog & Crabill, our traffic engineers made adjustments during non-peak times that may make conditions better.

PUBLIC COMMENTS:

Chuck Sylvia, 5081 Kearsarge, New Dutch Haven

Mr. Sylvia stated that he attended previous meetings where the installation of protected-permissive signals was requested @ three intersections. He agreed with the decision at that time to deny the installation at Siboney Street because of visibility. Mr. Sylvia asked Mr. Hunt who made the request for the signal changes at the entrances to the Highlands. Mr. Hunt answered that Council members Kusumoto and Poe relayed those requests.

Mr. Sylvia has followed this item on behalf of members of the community who have supported him over the years. He is now in the position of telling them that the protected-permissive signals will not be going in.

He stated that he is confused because there are areas on Los Alamitos Boulevard where drivers have to make left-turns across three lanes of northbound traffic and merge into a southbound lane (Harrisburg, Von's Shopping Center, Howard, and Green). He does not see how making a left-turn into Rossmoor is more dangerous. Mr. Hunt explained the factors affecting sight distance.

COMMISSIONER DISCUSSION:

Commissioner Emerson stated that he is in support of the adjustments made to the Rossmoor Way and Bradbury Road signals, which allow them to operate on demand between the hours of 9 AM to 3:30 PM, and 7 PM to 7:00 AM. Suggested seeing how the Highlands residents feel about the new timing works out, and come back in 4 to 5 months.

Discussion of the following items followed:

- If the Commission overrides staff's recommendation, does the City assume some liability?

  Mr. Hunt answered that yes, the City will be exposed to some liability.

- Would it be possible to shorten the current cycle length from 100 seconds to 1 minute?

  Mr. Cabey stated that the section of roadway from Farquhar Avenue to the 405 Freeway is synchronized with other signals and that adjustment would throw the signals out of synchronization with the rest of the system. Additionally, new requirements are coming up that will require an extension of the pedestrian signal @ Los Alamitos Blvd. & Katella Ave.

- Sitting and waiting at the light is frustrating. Shorten the wait time to make as many people happy as we can is a fair compromise.

  Mr. Cabey stated that signal coordination is for peak volumes of traffic and left-turns can be favored during synchronization.

- Perception is that vehicles making a left-turn into the Highlands are the last to get the green. Opposing traffic seems to trigger the cycle, and southbound vehicles have to wait.

  The adjustments made to the signal timing should remedy this during non-peak hours.

- Majority of complaints come from the wait for southbound left-turn. Would it be possible to let the southbound left-turn go before the northbound left turn, and explore the possibility of narrowing the peak hours?

  Greg Cabey explained how the signals 'lead and lag' during synchronization, and the challenges or working within parameters presented by the synchronization of the signals from the 405 freeway to Farquhar Avenue.

MOTION: SCHLEUTER/MURPHY: Motion was made to observe changes made by the Traffic Engineer (signals operate on demand between the hours of 9 AM to 3:30 PM, and 7 PM to 7:00 AM); and bring back this issue in 2 months. Also, bring back traffic count data to justify peak time adjustments. Motion unanimously carried.

A. REQUEST TO INSTALL "KEEP CLEAR" STRIPING AT THE LOS ALAMITOS HIGH SCHOOL TEACHER PARKING ENTRANCE DRIVEWAY ON LOS ALAMITOS BOULEVARD, AND FARQUHAR AVENUE AND ROCHELLE STREET

City Engineer, Dave Hunt, gave summary of the staff report and the information contained therein.

COMMENTS FROM PUBLIC:

Art De Bolt – resident on Rochelle St. – has never seen intersection blocked. By law, don't intersections have to be kept clear? He is concerned about sign blight. Thinks solution is to have police give tickets to discourage vehicles blocking the intersection. Also suggested opening up Farquhar Avenue @ Los Alamitos Blvd. by making two left-lane turn lanes; and block off alley before Los Alamitos Blvd. Mr. De Bolt stated that he had been informed that the Traffic Commission had previously approved blocking off that alley.

Mr. Hunt stated that he received a resident complaint about the intersection. He also stated that improvements on Farquhar Ave. were approved as part of the Traffic Calming report done in 2005. It was designated as a Priority 3 project, and at this time there is no money available.

Although 'Keep Clear Zones' on the pavement are effective, restricting signage blight is also important. The pavement marking must be accompanied by signage. Moving traffic on Farquhar Ave. is the real issue. Need to address evaluating Farquhar Ave. as a whole.

Suggestion was made to defer painting both areas. Look at other solutions for traffic on Farquhar Ave. and work on a comprehensive solution on Los Alamitos Blvd. with the school.

Mr. De Bolt recalled that ten years ago the Base was restricted from using Farquhar Ave. as a transit point. City staff might need to re-visit that issue.

MOTION: MURPHY/SCHLEUTER: A motion was made to deny the recommendation to install "KEEP CLEAR" striping at the Los Alamitos High School teacher parking entrance driveway on Los Alamitos Boulevard, and Farquhar Avenue and Rochelle Street. Motion was unanimously carried.

The Commission would like to have staff coordinate a meeting with the School District to discuss a comprehensive approach for traffic issues around the High School.

B. APARTMENT ROW RED CURB PAINTING PRIORITY 1 PROJECTS – Continued

City Engineer, Dave Hunt gave summary of the agenda report and information contained therein. Staff is recommending removing the red curb at two locations on Farquhar Avenue and having the Traffic Engineer conduct a warrant study for five (5) intersections in Apartment Row to investigate whether or not a 4-way stop is justified. The intersections to be included are: Howard and Reagan, Bloomfield and Green, Bloomfield and Howard, Noel and Green and Noel and Howard. Mr. Hunt explained that the cost to do warrant studies for five (5) intersections needing 4-way stops is $10,000.

PUBLIC COMMENT:

Mr. De Bolt stated that he is in agreement with the City Engineer. In the Apartment Row area, he feels stop signs are needed at every intersection, and if there is a parking problem there, the City has exacerbated it with red curbs. Red curbs can be eliminated by putting in stop signs. He has not ever had anyone who lives in Apartment Row complain about not being able to find a place to park. He thinks it is a good move to get rid of red curbs and get 4-way stops. Suggests garage door openers be required on any new construction to encourage parking in garages.

COMMISSIONERS' COMMENTS:

- Red curbs can be eliminated if stop signs are put in.
- Concerned with cost of warrant studies for stop signs.
- Stop signs will improve safety for vehicles exiting alleys without impacting parking by putting in more red curbs.
- Possible to do one warrant study that could apply to all the intersections?
- Get Council Member Mejia on board with 4-way stops. See if Council and Commission will override warrant studies.
- Need City Attorney's advice on necessity of warrants.

Dave Hunt stated that he feels the money for the warrant studies is well spent. The studies are part of the process and steps that need to be taken before the stop signs are put in.

Commissioner Murphy presented a challenge to Commission to look at the whole area, making it more resident-friendly, and less pass-through friendly. Increase safety with a series of small solutions; moving forward with a comprehensive plan.

MOTION: SCHLEUTER/MURPHY: Request City Engineer to conduct warrant studies for five (5) intersections (Howard and Reagan, Bloomfield and Green, Bloomfield and Howard, Noel and Green, and Noel and Howard) in Apartment Row for 4-way stops. Allow him to follow whatever procedures necessary to remove red curbs at 3691 and 4125 Farquhar Avenue. Motion passed with 5 ayes; 1 opposed (Emerson).

Commissioner Murphy expressed his pleasure at having worked with the Traffic Commission.

8. ITEMS FROM THE PUBLIC WORKS DEPARTMENT

None

9. TRAFFIC COMMISSION INITIATED BUSINESS

- Commissioner Emerson requested that discussion of reducing traffic on Farquhar Avenue traffic issues be agendized, specifically:
  - ✓ Options for the intersection of Lexington Drive and Farquhar Avenue
  - ✓ No left-turn for traffic exiting the Base
  - ✓ Issues relating to the intersection of Farquhar Avenue and Los Alamitos Boulevard with option to make 2 left-turn lanes on Farquhar Ave.
  - ✓ Addressing the alley that dead ends on Farquhar
  - ✓ Use of Orangewood as exit only for the Base during peak periods

- Commissioner Emerson would like to address minimizing impact to traffic of the construction planned for the Medical Center.

10. ADJOURNMENT

Motion/Second: SCHLEUTER/MURPHY
There being no further business the meeting was adjourned in memory of Traffic Commissioner, Pauline Bloom, at 10:10 p.m., to the next regularly scheduled meeting of January 9, 2013, at 7:00 p.m.

_____
Dave Hunt, City Engineer

TRAFFIC COMMISSION UPDATED STATUS LIST - 2015-2016

ITEM		DESCRIPTION	DATE INITIATED	REQUESTED BY	COUNCIL OR STAFF	TAKEN TO T.C.	TAKEN TO C.C.	REMARKS
A		**RECOMMENDATION APPROVED/COMPLETED**						
A	1	Install 4-way stop signs at 4-way stop intersections.	Jul-15	J. Wilhelm				Completed
A -	2	Farquhar/Los Alamitos Alley Study		Emerson/Mejia				Completed
A -	3	No Left Turn sign by the Post Office on Reagan St	Jun-15	D. Patz				Completed
A-	4	Katella/Cherry crosswalk on East side of Katella - move to west side.	Jun-15	J. Mejia				Completed - Put on 7-yr CIP
A-	5	High School Traffic Study		D. Hunt		Apr-15		Completed -Needs Los Al Unified approval
A-	6	Extend signal time for cars crossing Katella @ Walnut/Wallingford	Apr-June-15	Lindsey				Completed
A-	7	Repaint arrows at bus pad on Katella @ Walnut	Apr-15	J. Mejia				Completed
A-	8	3-Way Stop Sign @ Cherry St & Catalina St	Jan-13	J. Wilhelm		May-15	Jun-15	Completed
A-	9	Consider options for widening Civic Center Dr	Jan-14	J. Mejia				Included in development
A	10	Upgrade fork-lift crossing on Catalina	Jan-16	J. Mejia				Completed
B		**RECOMMENDATION APPROVED & PENDING IMPLEMENTATION**						
B-	1	Modifications to Katella/Wallingsford-Walnut for school ped safety	Jul-15	Rossmoor HOA	Possibly Council	Nov-15		Conducting follow-up
C		**RECOMMENDATION DENIED**						
D		**ITEMS PENDING CONSIDERATION - TRAFFIC COMMISSION**						
E		**ITEMS PENDING CONSIDERATION - CITY COUNCIL**						
E-	1	Piggy-back on Seal Beach Bl signal synch OCTA program for Los Alamitos Bl	Jan-16	D. Emerson	Council	Mar-16		On proposed 7-yr CIP (unfunded)
F		**TRAFFIC COMMISSION INITIATED ITEMS - ENGINEERING**						
F -	1	Modify pedestrian signal/sign for NB right turns - East leg Bloomfield & Katella	Jan-14	J. Wilhelm	Staff			Reviewing
F -	3	Address sight distance for driveways on S/S Katella - Reagan to Cherry	Mar-16	J. Wilhelm	Possibly Council			Reviewing (will return to Comm.)
F -	4	Replace/repaint Xwalks & stop signs-no reflectivity at night on Farquhar from Noel to Los Alamitos Bl	Apr-16	J. Mejia	Staff			Stop sign replaced bid out to repaint Farquad
F -	5	Remove parking spaces on S/S Catalina opposite Trend docks	Mar-16	J. Mejia	Possibly Council			Reviewing

Updated 7/7/2016

TRAFFIC COMMISSION UPDATED STATUS LIST - 2015-2016

ITEM		DESCRIPTION	DATE INITIATED	REQUESTED BY	COUNCIL OR STAFF	TAKEN TO T.C.	TAKEN TO C.C.	REMARKS
F -	6	Move or upgrade mid-block crosswalk on Cherry s/o Florista	Mar-16	J. Mejia & D. Patz	Possibly Council			Reviewing
F -	7	Bring the traffic study for Shea Properties Arrowhead to Commission	Mar-16	J. Mejia	Staff			Waiting for study to be submitted
F -	8	Remove school signs for Laurel HS, which is closed	Nov-15	D. Patz	Staff			Confirmed - Staff will remove
F -	9	Remove "left over" limit line at Farquhar/Pine (from Keep Clear)	Jun-16	D. Emerson	Staff			Limit lines and Pavement Marking to remain per TC meeting 6/9/16. No Action needed
F -	10	Remove "Keep Clear" on Farquhar at Cherry	Mar-16	D. Emerson	Staff			Reviewing it. TC want them removed per 6/9/16
F -	11	Street name signs at Los Alamitos Bl/Florista-paint/vinyl pealing off	Jan-16	J. Seaman	Staff			Part of Citywide replacement
F -	12	Replace speed bumps in alley - poor condition	Jan-16	J. Mejia	Staff			Ordering new ones
F -	13	Vehicles in N/bound left turn lanes on Los Alamitos at Katella back up into thru lane	Jan-16	D. Emerson	Council			Reviewing - Would likely require capital improvements
F -	14	Add red curb for sight distance on Katella for n/bound Bloomfield	Mar-16	D. Emerson	Possibly Council			Reviewing - Clarification needed from Commissioner
F -	15	PT/P Study to downgrade fully protected operationfor Rosmoor Way/Los Alamitos TS and Bradbury/Los Alamitos TS S/B and N/B directions	Jun-16	D. Emerson	Staff			Reviewing - Found Traffic Reports by HC on this item

Updated 7/7/2016